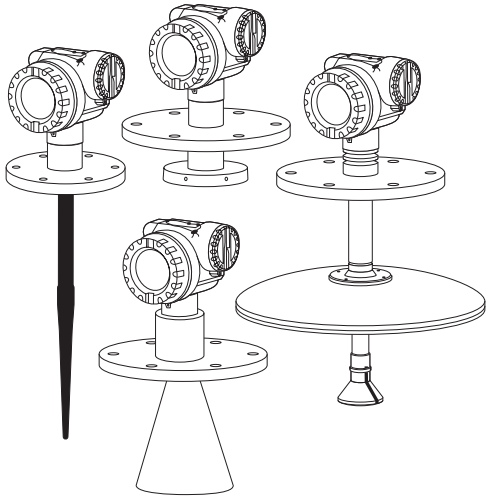
SRM002FVAE0804

# Radar Tank Gauge

Smart Transmitter for continuous and non-contact precision level measurement. For custody transfer and inventory-control applications with NMI and PTB approval.

## *Service Manual and Description of Instrument Functions*



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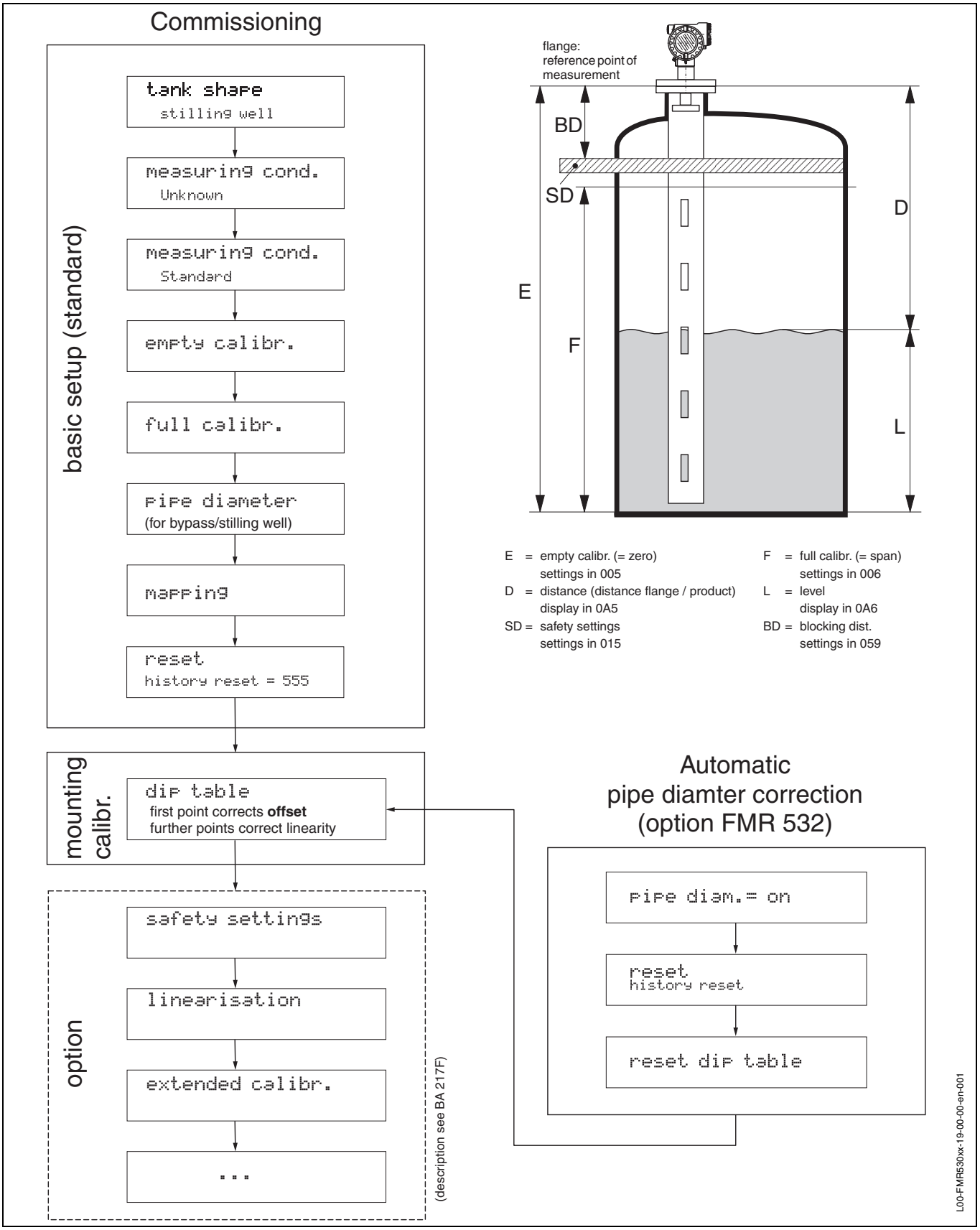
# Basic Setup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basic setup (standard)
tank shape
stilling well
measuring cond.
Unknown
measuring cond.
Standard
empty calibr.
full calibr.
pipe diameter
(for bypass/stilling well)
mapping
reset
history reset = 555
mounting calibr.
dip table
first point corrects offset
further points correct linearity
option
safety settings
linearisation
extended calibr.
...
(description see BA 217F)
flange:
reference point of measurement
BD
SD
E
F
D
L
E = empty calibr. (= zero)
settings in 005
D = distance (distance flange / product)
display in 0A5
SD = safety settings
settings in 015
F = full calibr. (= span)
settings in 006
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Automatic
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L00-FMR530xx-19-00-00-en-001

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# 1 Safety Instructions

## 1.1 Designated use

The Varec Model 7500 Radar Tank Gauge (RTG) is a compact radar level transmitter for the continuous, contactless measurement of liquids, pastes and sludge in stilling wells. The device can also be freely mounted outside closed metal vessels because of its operating frequency of about 6 GHz and a maximum radiated pulsed energy of 1mW (average power output 1 μW). Operation is completely harmless to humans and animals.

## 1.2 Installation, commissioning and operation

The 7500 RTG has been designed to operate safely in accordance with current technical, safety and EU standards. If installed incorrectly or used for applications for which it is not intended, however, it is possible that application-related dangers may arise, e.g. product overflow due to incorrect installation or calibration. For this reason, the instrument must be installed, connected, operated and maintained according to the instructions in this manual: personnel must be authorised and suitably qualified. The manual must have been read and understood, and the instructions followed. Modifications and repairs to the device are permissible only when they are expressly approved in the manual.

## 1.3 Operational safety

**Hazardous areas**
Measuring systems for use in hazardous environments are accompanied by separate "Ex documentation", which is an *integral part* of this Operating Manual. Strict compliance with the installation instructions and ratings as stated in this supplementary documentation is mandatory.

- Ensure that all personnel are suitably qualified.
- Observe the specifications in the certificate as well as national and local regulations.

**FCC-approval**
This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

**Caution!**
Changes or modifications not expressly approved by the part responsible for compliance could void the user's authority to operate the equipment.

## 1.4 Return

The following procedures must be carried out before a transmitter is sent to Varec for repair:

- Always enclose a duly completed “Declaration of contamination” form. Only then can Varec transport, examine and repair a returned device.
- Enclose special handling instructions if necessary, for example a safety data sheet as per EN 91/155/EEC.
- Remove all residue which may be present. Pay special attention to the gasket grooves and crevices where fluid may be present. This is especially important if the fluid is dangerous to health, e.g. corrosive, poisonous, carcinogenic, radioactive, etc.

**Caution!**

- No instrument should be sent back for repair without all dangerous material being completely removed first, e.g. in scratches or diffused through plastic.
- Incomplete cleaning of the instrument may result in waste disposal or cause harm to personnel (burns, etc.). Any costs arising from this will be charged to the operator of the instrument.

## 1.5 Notes on safety conventions and symbols

In order to highlight safety-relevant or alternative operating procedures in the manual, the following conventions have been used, each indicated by a corresponding symbol in the margin.

### Safety conventions

| Symbol | Meaning |
|---|---|
| Warning! | A warning highlights actions or procedures which, if not performed correctly, will lead to personal injury, a safety hazard or destruction of the instrument |
| Caution! | Caution highlights actions or procedures which, if not performed correctly, may lead to personal injury or incorrect functioning of the instrument |
| Note! | A note highlights actions or procedures which, if not performed correctly, may indirectly affect operation or may lead to an instrument response which is not planned |

### Explosion protection

| | |
|---|---|
| | **Device certified for use in explosion hazardous area**<br>If the 7533 RTG has this symbol embossed on its name plate it can be installed in an explosion hazardous area |
| | **Explosion hazardous area**<br>Symbol used in drawings to indicate explosion hazardous areas.<br>– Devices located in and wiring entering areas with the designation “explosion hazardous areas” must conform with the stated type of protection |
| | **Safe area (non-explosion hazardous area)**<br>Symbol used in drawings to indicate, if necessary, non-explosion hazardous areas.<br>– Devices located in safe areas still require a certificate if their outputs run into explosion hazardous areas. |

### Electrical symbols

| | |
|---|---|
| | **Direct voltage**<br>A terminal to which or from which a direct current or voltage may be applied or supplied |
|  | **Alternating voltage**<br>A terminal to which or from which an alternating (sine-wave) current or voltage may be applied or supplied |
| | **Grounded terminal**<br>A grounded terminal, which as far as the operator is concerned, is already grounded by means of an earth grounding system |
| | **Protective grounding (earth) terminal**<br>A terminal which must be connected to earth ground prior to making any other connection to the equipment |
| | **Equipotential connection (earth bonding)**<br>A connection made to the plant grounding system which may be of type e.g. neutral star or equipotential line according to national or company practice |

# 2 Notes on use

You have various options for accessing the descriptions of instrument functions or how to enter parameters.

## 2.1 Using the table of contents to locate a function description

All the functions are listed in the table of contents sorted by function group (e.g. basic setup, safety settings, etc.). You can access a more detailed description of a function by using a page reference / link.
The table of contents is on page 3.

## 2.2 Using the graphic of the function menu to locate a function description

This guides you step by step from the highest level, the function groups, to the exact function description you require.

All the available function groups and instrument functions are listed in the table (see page 19). Select your required function group or function. You can access an exact description of the function group or function by using a page reference / link.

## 2.3 Using the index of the function menu to locate a function description

To simply navigation within the function menu, each function has a position which is shown in the display. You can access each function via a page reference/link in the function menu index (see page 19) which lists all the function names alphabetically and numerically.

## 2.4 General structure of the operating menu

The operating menu is made up of two levels:

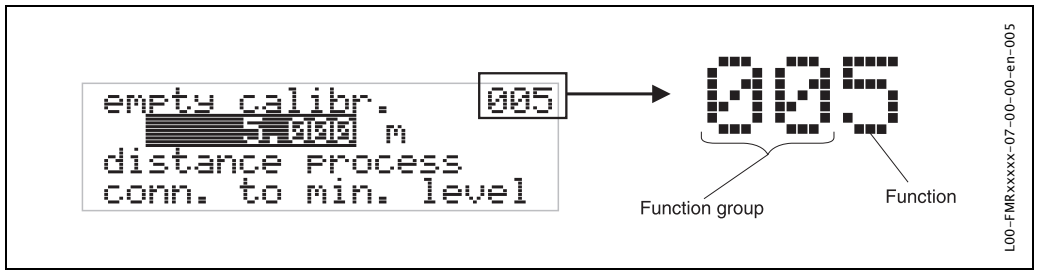
- **Function groups (00, 01, 03, …, 0C, 0D):**
  The individual operating Selection of the instrument are split up roughly into different function groups. The function groups that are available include, e.g.: "**basic setup**", "**safety settings**", "**output**", "**display**", etc.
- **Functions (001, 002, 003, …, 0D8, 0D9):**
  Each function group consists of one or more functions. The functions perform the actual operation or parameterisation of the instrument. Numerical values can be entered here and parameters can be selected and saved. The available functions of the "**basic setup (00)**" function group include, e.g.: "**tank shape (002)**", "**medium property (003)**", "**process cond. (004)**", "**empty calibr. (005)**", etc.

If, for example, the application of the instrument is to be changed, carry out the following procedure:

1.Select the "**basic setup (00)**" function group.
2.Select the "**tank shape (002)**" function (where the existing tank shape is selected).

## 2.5 Identifying the functions

For simple orientation within the function menus (see page 19), for each function a position is shown on the display.




The first two digits identify the function group:

- basic setup **00**
- safety settings **01**
- linearisation **04**

…

The third digit numbers the individual functions within the function group:

- basic setup **00** → 
  - tank shape **002**
  - medium property **003**
  - process cond. **004**

  …

Hereafter the position is always given in brackets (e.g. "**tank shape**" **(002)**) after the described function.

## 2.6 Display and operating elements

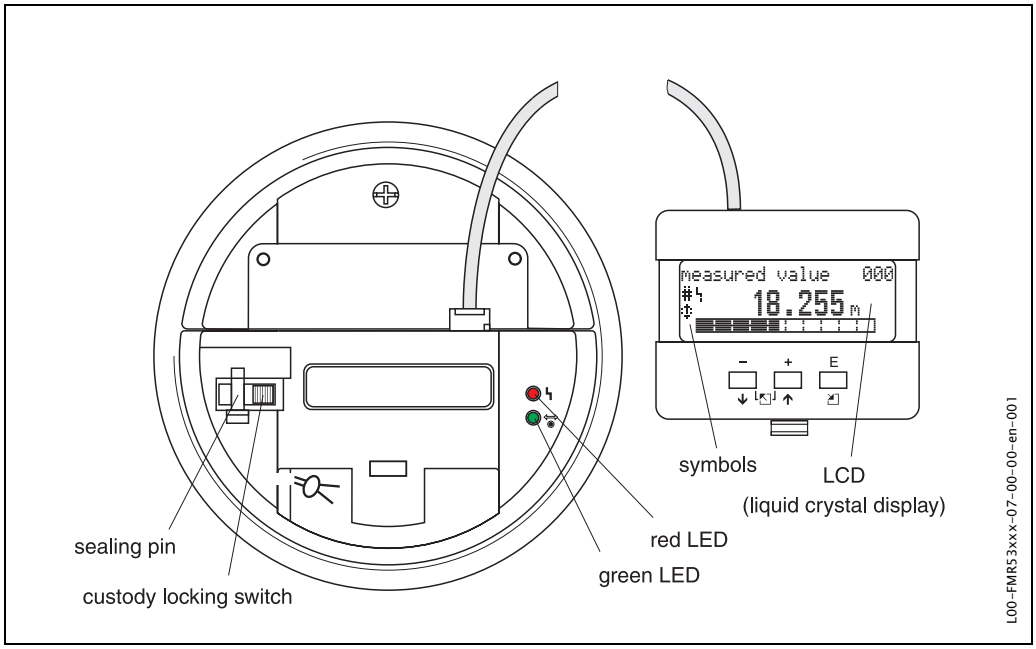



Figure 1: Layout of the display and operating elements

### 2.6.1 Display

**Liquid crystal display (LCD):**
Four lines with 20 characters each. Display contrast adjustable through key combination.

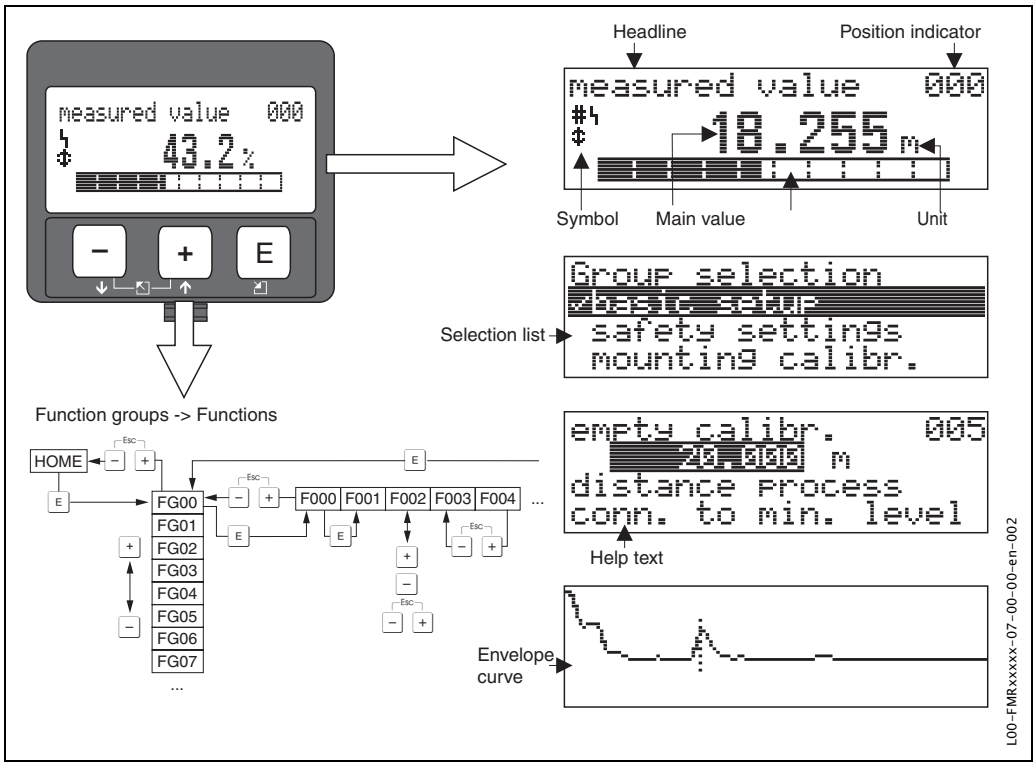



Figure 2: Display

### 2.6.2 Display symbols

The following table describes the symbols that appear on the liquid crystal display:

| Symbols | Meaning |
|---|---|
| | ALARM_SYMBOL<br>This alarm symbol appears when the instrument is in an alarm state. If the symbol flashes, this indicates a warning. |
| | LOCK_SYMBOL<br>This lock symbol appears when the instrument is locked,i.e. if no input is possible. |
| | COM_SYMBOL<br>This communication symbol appears when a data transmission via e.g. HART, PFOFIBUS-PA or Foundation Fieldbus is in progress. |
| | Calibration to regulatory standards disturbed<br>If the instrument is not locked or it cannot guarantee the calibration to regulatory standards, the situation will be indicated on the display via the symbol. |

*Table 1: Meaning of Symbols*

**Light emitting diodes (LEDs):**
There is a green and a red LED besides the Liquid Crystal Display.

| LED | Meaning |
|---|---|
| red LED continuously on | Alarm |
| red LED flashes | Warning |
| red LED off | No alarm |
| green LED continuously on | Operation |
| Green LED flashes | Communication with external device |

## 2.6.3 Key assignment

The operating elements are located inside the housing and are accessible for operation by opening the lid of the housing.

**Function of the keys**

| Key(s) | Meaning |
|---|---|
| [+] or [↑] | Navigate upwards in the selection list<br>Edit numeric value within a function |
| [–] or [↓] | Navigate downwards in the selection list<br>Edit numeric value within a function |
| [Esc] [–] [+] or [←] | Navigate to the left within a function group |
| [E] or [E] | Navigate to the right within a function group, confirmation. |
| [+] and [E]<br>or<br>[–] and [E] | Contrast settings of the LCD |
| [+] and [–] and [E] | Hardware lock / unlock<br>After a hardware lock, an operation of the instrument via display or communication is not possible!<br>The hardware can only be unlocked via the display. An unlock parameter must be entered to do so. |

*Table 2: Function of the keys*

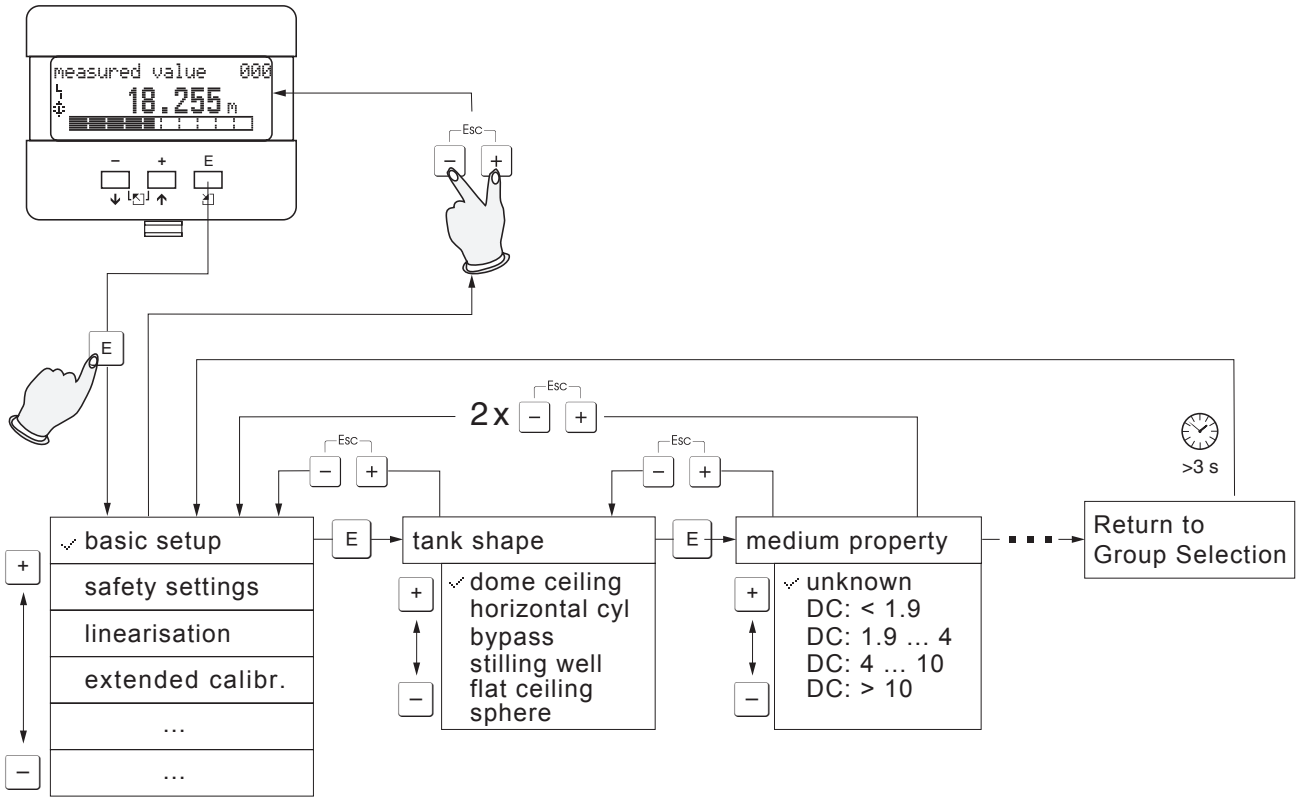
**Custody locking switch**
Access to the electronics can be prevented by means of a custody locking switch that locks the device settings. The custody locking switch can be sealed for custody transfer applications.

**Software reliability**
The software used in the 7500 RTG radar instruments fulfills the requirements of OIML R85. This particularly includes:

- cyclical test of data consistency
- non-volatile memory
- segmented data storage

The 7500 RTG radar instruments continuously monitor the compliance with accuracy requirements for custody transfer measurements according to OIML R85. If the accuracy cannot be maintained, a specific alarm is generated on the local display and via the digital communication.

## 2.6.4 Operation with the VU 331




**Selection and configuration in Operation menu:**

1.) Change from Measured Value Display to **Group Selection** by pressing [E]

2.) Press [–] or [+] to select the required **Function Group** (e.g.. "basic setup (00)") and confirm by pressing [E] ➜ First f**unction** (e.g. "tank shape (002)") is selected.

**Note!**
The active selection is marked by a ⋰ in front of the menu text.

3.) Activate Edit mode with [+] or [–].

**Selection menus:**

a) Select the required **Parameter** in selected **function** (e.g. "tank shape (002)") with [–] or [+].
b) [E] confirms selection ➜ ⋰ appears in front of the selected parameter
c) [E] confirms the edited value ➜ system quits Edit mode
d) [+] + [–] (= [Esc]) interrupts selection ➜ system quits Edit mode

**Typing in numerals and text:**

a) Press [+] or [–] to edit the first character of the **numeral / text** (e.g. "empty calibr. (005)")
b) [E] positions the cursor at the next character ➜ continue with (a) until you have completed your input
c) if a ↵ symbol appears at the cursor, press [E] to accept the value entered
➜ system quits Edit mode
d) [+] + [–] (= [Esc]) interrupts the input, system quits Edit mode

4) Press [E] to select the next **function** (e.g. "medium property (003)")

5) Press [+] + [–] (= [Esc]) once ➜ return to previous **function** (e.g. "tank shape (002)")
Press [+] + [–] (= [Esc]) twice ➜ return to **Group selection**

6) Press [+] + [–] (= [Esc]) to return to **Measured value display**

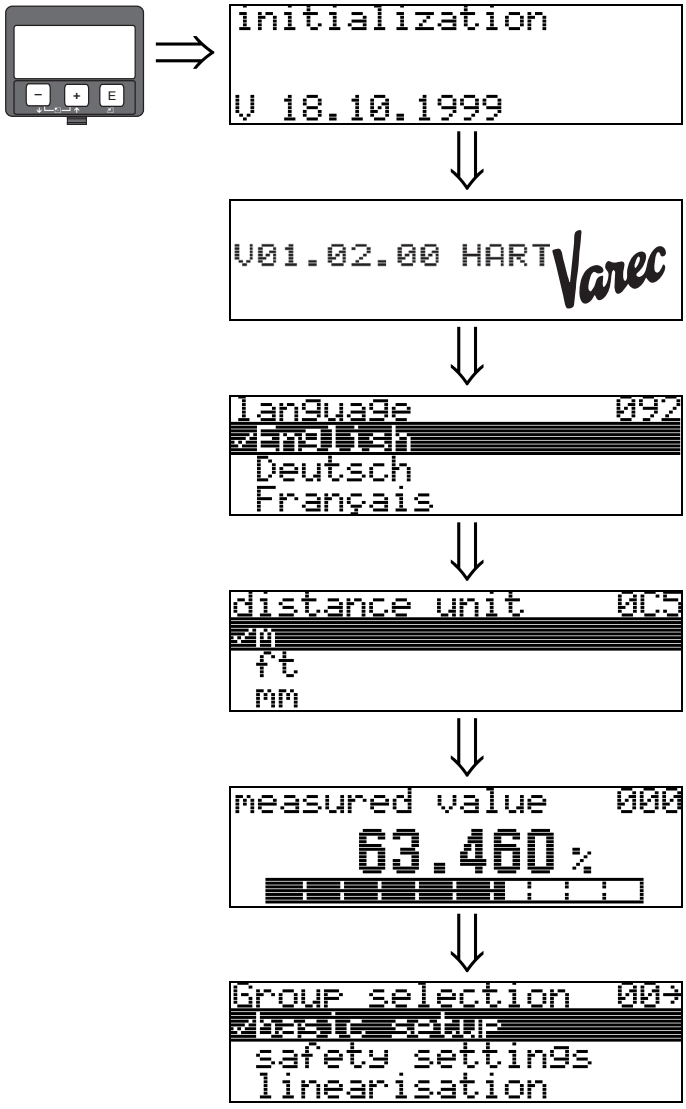
L00-FMR2xxxx-19-00-00-en-001

Figure 3: Selection and configuration in operation menu

## 2.7 Commissioning

### 2.7.1 Switching on the measuring device

When the instrument is switched on for the first time, the following messages appear on the display:




After 5 s, the following message appears

After 5 s or after you have pressed [E] the following message appears

Select the language
(this message appears the first time the instrument is switched on)

Select the basic unit
(this message appears the first time the instrument is switched on)

The current measured value is displayed

After [E] is pressed, you reach the group selection.

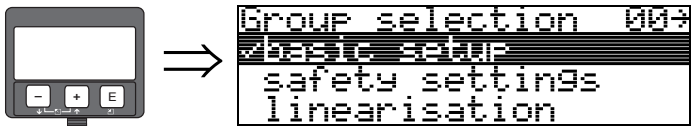
This selection enables you to perform the basic setup

# 3 7500 RTG Function menu

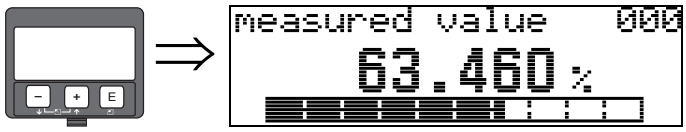
| Function group | | Function | | | Description |
|---|---|---|---|---|---|
| **basic setup** | 00 | measured value | 000 | → | Page 21 |
| (see page 21) | | tank shape | 002 | → | Page 21 |
| ⇓ | | medium property | 003 | → | Page 22 |
| | | process cond. | 004 | → | Page 23 |
| | | empty calibr. | 005 | → | Page 24 |
| | | full calibr. | 006 | → | Page 25 |
| | | pipe diameter | 007 | → | Page 26 |
| | | check distance | 051 | → | Page 27 |
| | | range of mapping | 052 | → | Page 28 |
| | | start mapping | 053 | → | Page 28 |
| | | history reset | 009 | → | Page 29 |
| **safety settings** | 01 | output on alarm | 010 | → | Page 31 |
| (see page 31) | | output on alarm | 011 | → | Page 33 |
| ⇓ | | outp. echo loss | 012 | → | Page 33 |
| | | ramp %span/min | 013 | → | Page 34 |
| | | delay time | 014 | → | Page 35 |
| | | safety distance | 015 | → | Page 35 |
| | | in safety dist. | 016 | → | Page 35 |
| | | ackn. alarm | 017 | → | Page 37 |
| | | overspill prot. | 018 | → | Page 37 |
| **mounting calibr.** | 03 | tank gauging | 030 | → | Page 39 |
| (see page 39) | | auto correction | 031 | → | Page 39 |
| ⇓ | | pipe diam.corr. | 032 | → | Page 40 |
| | | dip table mode | 033 | → | Page 42 |
| | | dip table | 034 | → | Page 44 |
| | | dip table | 035 | → | Page 44 |
| | | dip table handl. | 036 | → | Page 45 |
| | | dip table state | 037 | → | Page 46 |
| **linearisation** | 04 | level/ullage | 040 | → | Page 47 |
| (see page 47) | | linearisation | 041 | → | Page 48 |
| ⇓ | | customer unit | 042 | → | Page 52 |
| | | table no. | 043 | → | Page 53 |
| | | input level | 044 | → | Page 53 |
| | | input volume | 045 | → | Page 54 |
| | | max. scale | 046 | → | Page 54 |
| | | diameter vessel | 047 | → | Page 54 |

| Function group | | Function | | | Description |
|---|---|---|---|---|---|
| **extended calibr.** | **05** | selection | 050 | → | Page 55 |
| (see page 55) | | check distance | 051 | → | Page 55 |
| ⇓ | | range of mapping | 052 | → | Page 56 |
| | | start mapping | 053 | → | Page 56 |
| | | pres. map dist. | 054 | → | Page 57 |
| | | cust. tank map | 055 | → | Page 57 |
| | | echo quality | 056 | → | Page 58 |
| | | offset | 057 | → | Page 58 |
| | | output damping | 058 | → | Page 59 |
| | | blocking dist. | 059 | → | Page 59 |
| **output** | **06** | commun. address | 060 | → | Seite 61 |
| (see page 61) | | no. of preambels | 061 | → | Page 61 |
| ⇓ | | thres. main val. | 062 | → | Page 62 |
| | | fixed current | 063 | → | Page 62 |
| | | fixed cur. value | 064 | → | Page 63 |
| | | simulation | 065 | → | Page 63 |
| | | simulation value | 066 | → | Page 63 |
| | | output current | 067 | → | Page 63 |
| **display** | **09** | language | 092 | → | Page 65 |
| (see page 65) | | back to home | 093 | → | Page 65 |
| ⇓ | | format display | 094 | → | Page 66 |
| | | no.of decimals | 095 | → | Page 66 |
| | | sep. character | 096 | → | Page 66 |
| | | display test | 097 | → | Page 67 |
| | | plot settings | 09A | → | Page 67 |
| | | recording curve | 09B | → | Page 67 |
| | | envelope curve | 09C | → | Page 68 |
| **diagnostics** | **0A** | present error | 0A0 | → | Page 72 |
| (see page 71) | | previous error | 0A1 | → | Page 72 |
| ⇓ | | clear last error | 0A2 | → | Page 72 |
| | | reset | 0A3 | → | Page 73 |
| | | unlock parameter | 0A4 | → | Page 74 |
| | | measured dist. | 0A5 | → | Page 75 |
| | | measured level | 0A6 | → | Page 75 |
| | | application par. | 0A8 | → | Page 76 |
| | | custody mode | 0A9 | → | Page 77 |
| **system parameter** | **0C** | tag no. | 0C0 | → | Page 79 |
| (see page 79) | | protocol+sw-no. | 0C2 | → | Page 79 |
| ⇓ | | software no. | 0C3 | | Page 79 |
| | | serial no. | 0C4 | → | Page 80 |
| | | distance unit | 0C5 | → | Page 80 |
| | | download mode | 0C8 | → | Page 81 |
| **service** | **D0 0** | service level | D00 | | Page 83 |

# 4 Function group "basic setup" (00)




## 4.1 Function "measured value" (000)




This function displays the current measured value in the selected unit (see "**customer unit**" **(042)** function). The number of places after decimal point can be selected in the "**no.of decimals**" **(095)** function. The length of the bargraph corresponds to the percentile value of the present measured value with regard to the span.

**Caution!**
When using an FAR 10 antenna extension, carry out an offset correction before the basic setup. Enter the value into the function "**offset**" **(057)** (see Page 58).

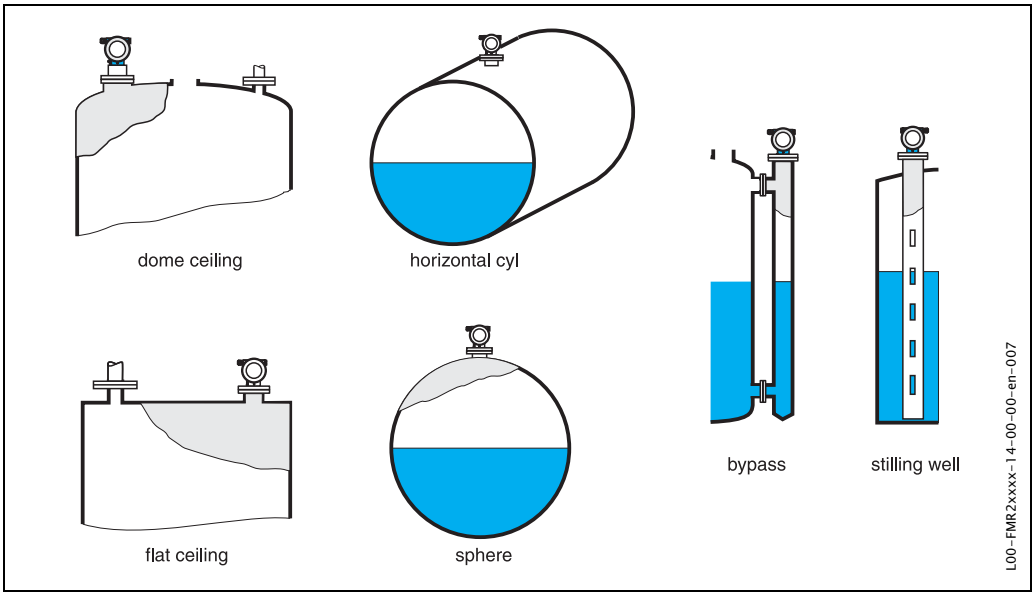
## 4.2 Function "tank shape" (002)

This function is used to select the tank shape.

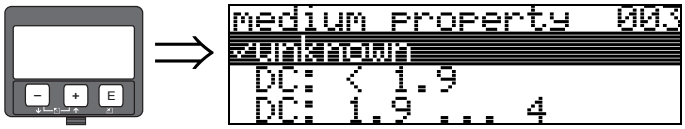
**Note!**
For the application of the 7532 RTG the selection "**stilling well**" has to be chosen in the function "**tank shape**" (002).

**Selection:**

- dome ceiling
- horizontal cyl
- bypass
- **stilling well** (factory setting for 7532 RTG)
- flat ceiling (factory setting for 7530 RTG, 7531 RTG, 7533 RTG. Typical ceiling of storage tanks: a slight slope of only a few degrees can be neglected.)
- sphere




## 4.3 Function "medium property" (003)




This function is used to select the dielectric constant.

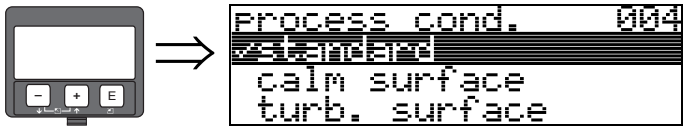
**Selection:**

- unknown
- < 1.9
- 1.9 ... 4
- 4 ... 10
- > 10

| Product class | DK ($\dot{V}$r) | Examples |
|---|---|---|
| **A** | 1,4 ... 1,9 | non-conducting liquids, e.g. liquefied gas [1)] |
| **B** | 1,9 ... 4 | non-conducting liquids, e.g. benzene, oil, toluene, ... |
| **C** | 4 ... 10 | e.g. concentrated acids, organic solvents, esters, aniline, alcohol, acetone, ... |
| **D** | > 10 | conducting liquids, e.g. aqueous solutions, dilute acids and alkalis |

1)Treat Ammonia NH3 as a medium of group A, i.e. always use a stilling well.

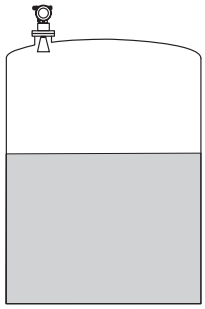
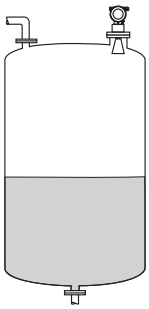
## 4.4 Function "process cond." (004)




This function is used to select the process conditions.

**Selection:**

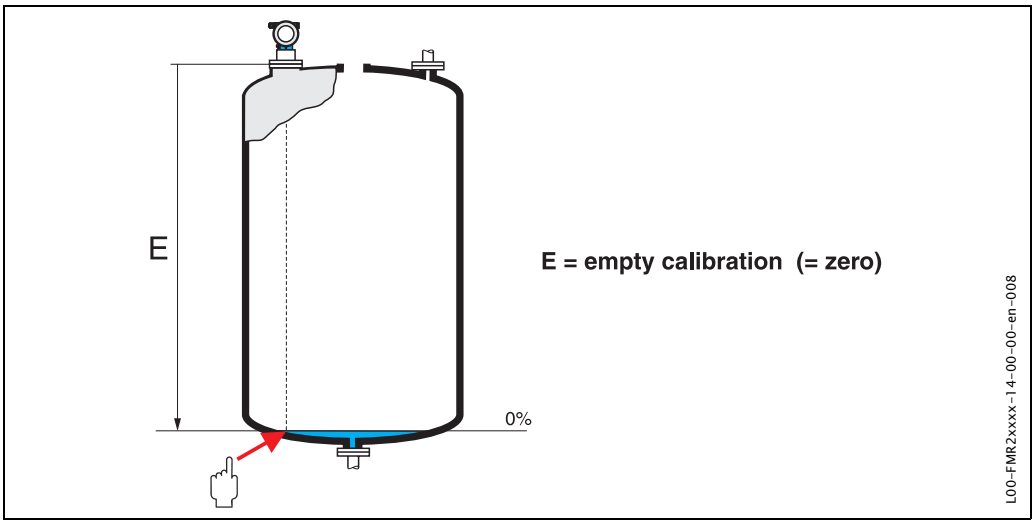
- standard
- calm surface
- turb. surface
- add. agitator
- fast change
- test:no filter

| standard | calm surface |
|---|---|
| For all applications that do not fit into any of the following groups. | Storage tanks with immersion tube or bottom filling |
|  |  |
| The filter and output damping are set to average values. | The averaging filters and output damping are set to high values.<br>-> steady meas. value<br>-> precise measurement<br>-> slower reaction time |

**Note!**
The phase evaluation of the 7500 RTG (see »Function "auto correction" (031)« on page 39) is only activated if you select the measuring conditions "**standard**" or "**calm surface**". We strongly recommend that, in the case of rough product surfaces or rapid filling, you activate the appropriate application parameters.

## 4.5 Function "empty calibr." (005)

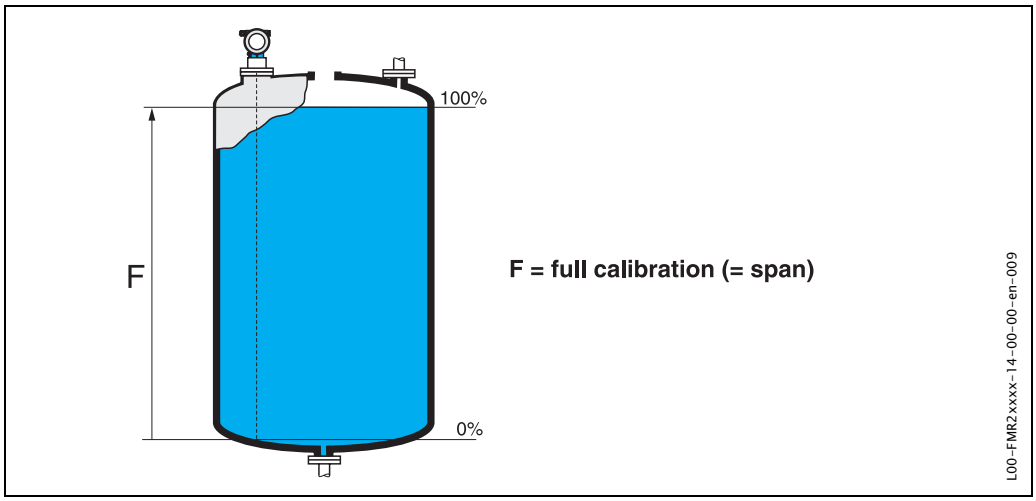
This function is used to enter the distance from the flange (reference point of the measurement) to the minimum level (=zero).




**Caution!**
For dish bottoms or conical outlets, the zero point should be no lower than the point at which the radar beam hits the bottom of the tank.

## 4.6 Function "full calibr." (006)

This function is used to enter the distance from the minimum level to the maximum level (=span).

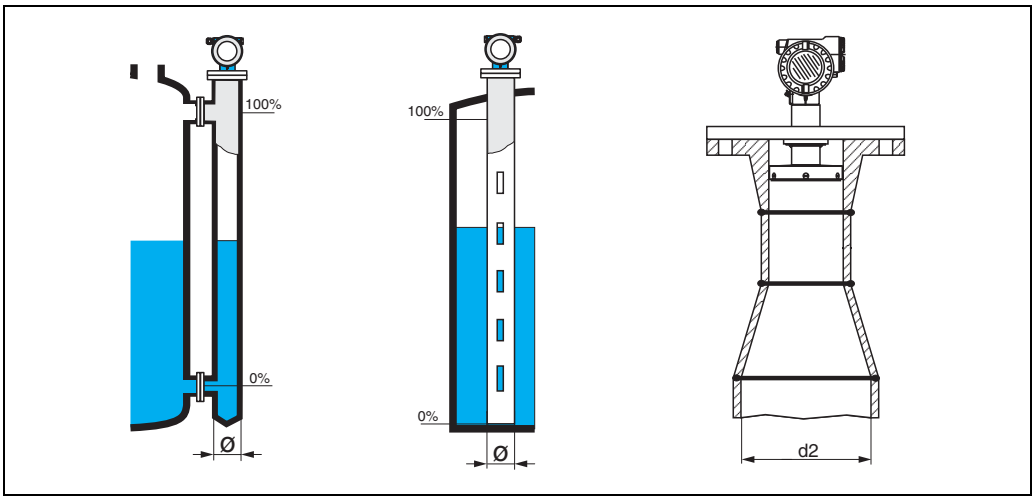



In principle, it is possible to measure up to the tip of the antenna. However, due to considerations regarding corrosion and build-up, the end of the measuring range should not be chosen any closer than 50 mm (2") to the tip of the antenna.

**Note!**
If **bypass** or **stilling well** was selected in the "**tank shape**" **(002)** function, the pipe diameter is requested in the following step.

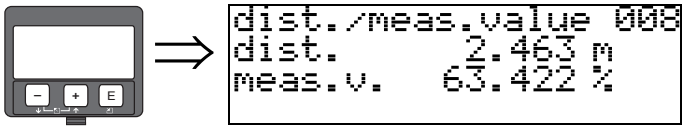
## 4.7 Function "pipe diameter" (007)

This function is used to enter the pipe diameter of the stilling well or bypass pipe.




Microwaves propagate slower in pipes than in free space. This effect depends on the inside diameter of the pipe and is automatically taken into account by the 7500 RTG. It is only necessary to enter the pipe diameter for applications in a bypass or stilling well. If mounting the 7532 RTG on stilling wells with a widening of the pipe, the **inner** diameter of the lower part of the pipe (d2 in the Fig.) must be entered. This is the part of the stilling well, where the measurement is actually performed.

## 4.8 Display (008)




The **distance** measured from the reference point to the product surface and the **level** calculated with the aid of the empty adjustment are displayed. Check whether the values correspond to the actual level or the actual distance. The following cases can occur:

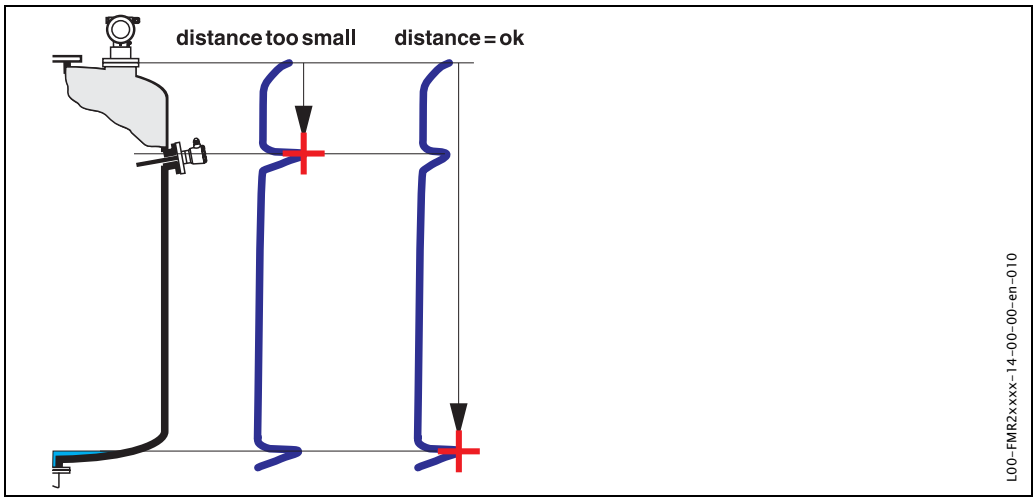
- Distance correct – level correct –> continue with the next function, "**check distance**" **(051)**
- Distance correct – level incorrect –> Check "**empty calibr.**" **(005)**
- Distance incorrect – level incorrect –> continue with the next function, "**check distance**" **(051)**

## 4.9 Function "check distance" (051)

This function triggers the mapping of interference echoes. To do so, the measured distance must be compared with the actual distance to the product surface. The following options are available for selection:

**Selection:**

- distance = ok
- dist. too small
- dist. too big
- dist. unknown
- manual




**distance = ok**

- mapping is carried out up to the currently measured echo
- The range to be suppressed is suggested in the "**range of mapping (052)**" function

Anyway, it is wise to carry out a mapping even in this case.

**dist. too small**

- At the moment, an interference is being evaluated
- Therefore, a mapping is carried out including the presently measured echoes
- The range to be suppressed is suggested in the "**range of mapping (052)**" function

**dist. too big**

- This error cannot be remedied by interference echo mapping
- Check the application parameters **(002), (003), (004)** and "**empty calibr.**" **(005)**

**dist. unknown**

If the actual distance is not known, no mapping can be carried out.

**manual**

A mapping is also possible by manual entry of the range to be suppressed. This entry is made in the "**range of mapping (052)**" function.

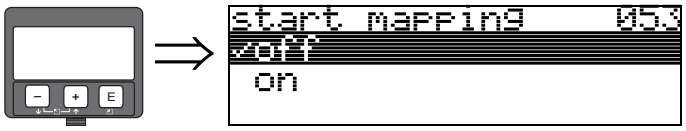
**Caution!**

The range of mapping must end 0.5 m (20") before the echo of the actual level. For an empty tank, do not enter E, but E – 0.5 m (20").

## 4.10 Function "range of mapping" (052)

This function displays the suggested range of mapping. The reference point is always the reference point of the measurement (see page 2). This value can be edited by the operator.
For manual mapping, the default value is: 0 m.

## 4.11 Function "start mapping" (053)

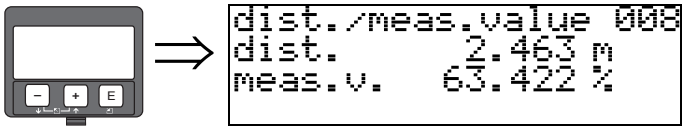



This function is used to start the interference echo mapping up to the distance given in "**range of mapping**" **(052)**.

**Selection:**

- **off**: no mapping is carried out
- on: mapping is started

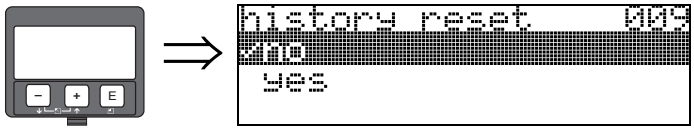
## 4.12 Display (008)




The distance measured from the reference point to the product surface and the level calculated with the aid of the empty alignment are displayed again. Check whether the values correspond to the actual level or the actual distance. The following cases can occur:

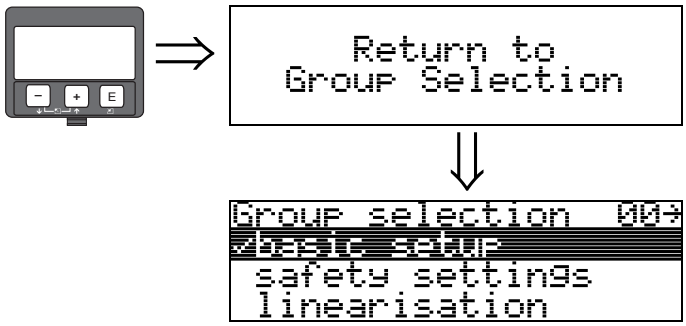
- Distance correct – level correct -> basic setup completed
- Distance incorrect – level incorrect -> a further interference echo mapping must be carried out "**check distance**" (**051)**.
- Distance correct – level incorrect -> check "**empty calibr.**" **(005)**

## 4.13 Function "history reset" (009)




By this function a history reset of the device is performed, i.e. the correspondence table between level an index values is deleted. A new correspondence table will be filled and stored after the history reset, for more information see page 39.

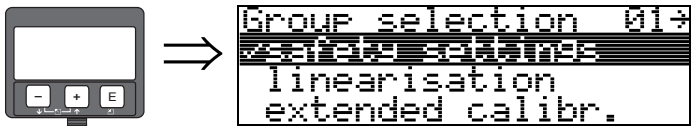
**Caution!**
Perform only after first installation (see »Function "auto correction" (031)« on page 39). In this case also effect a reset of the dip table in function "**dip table mode**" (033).




After 3 s, the following message appears

**Note!**
After the basic setup, an evaluation of the measurement with the aid of the envelope curve ("**display**" **(09)** function group) is recommended.

# 5 Function group "safety settings" (01)



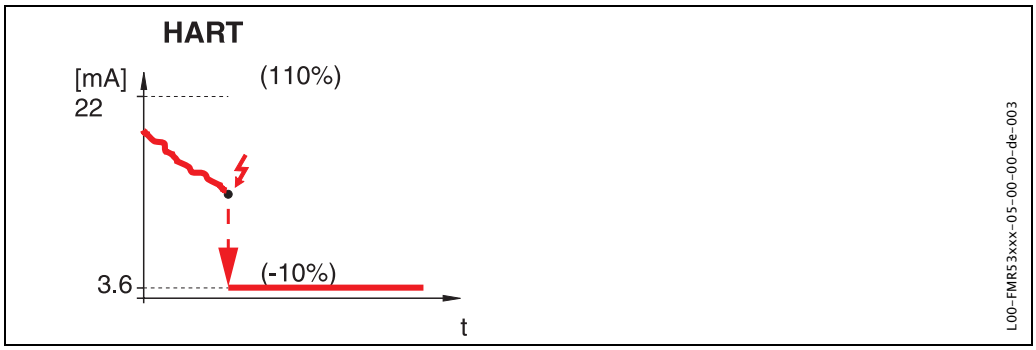

## 5.1 Function "output on alarm" (010)

This function is used to select the reaction of output on an alarm.

**Selection:**

- MIN –10% 3.6mA
- MAX 110% 22mA
- hold
- user specific

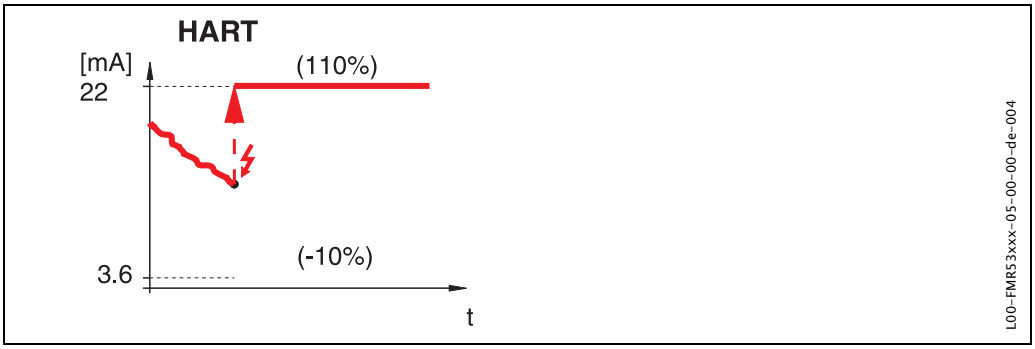
**MIN -10% 3.6mA**




If the instrument is in alarm state, the output changes as follows:

- HART:MIN–Alarm 3.6 mA

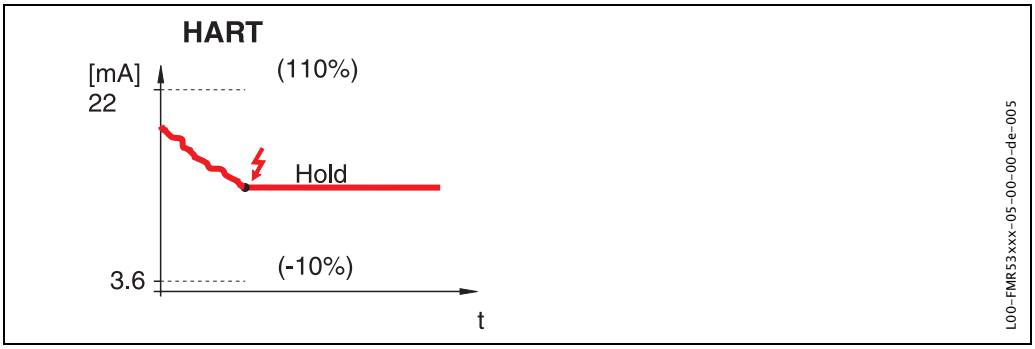
**MAX 110% 22mA**




If the instrument is in alarm state, the output changes as follows:

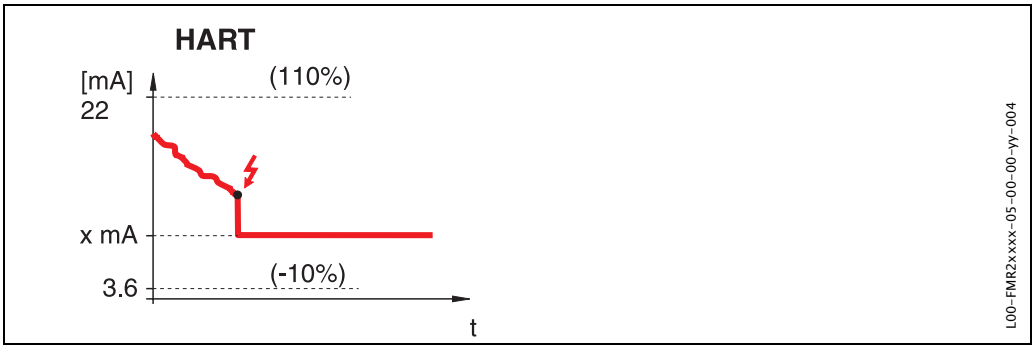
- HART:MAX-Alarm 22 mA

**hold**



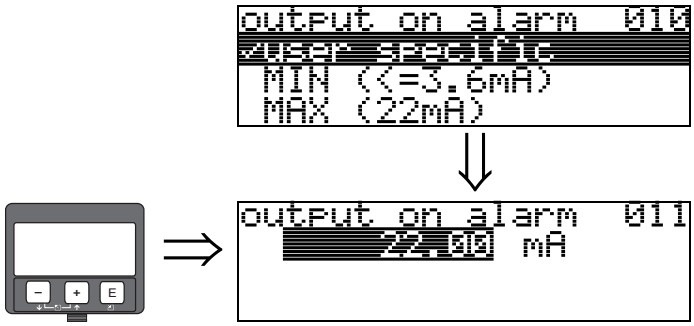

If the instrument is in alarm state, the last measured value is held.

**user specific**




If the instrument is in alarm state, the output is set to the value configured in "**output on alarm" (011)** (x mA).

## 5.2 Function "output on alarm" (011)




On alarm, the output current is in mA. This function is active when you selected "**x mA**" in the "**output on alarm**" **(010)** function.

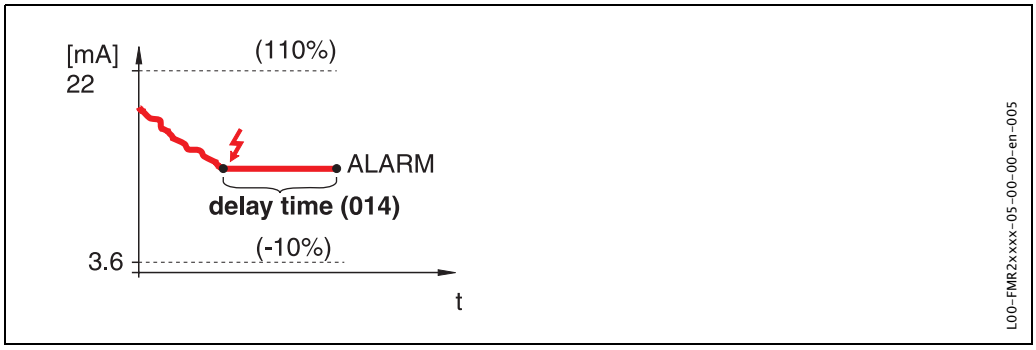
## 5.3 Function "outp. echo loss" (012)

Use this function to set the output response on echo loss.

**Selection:**

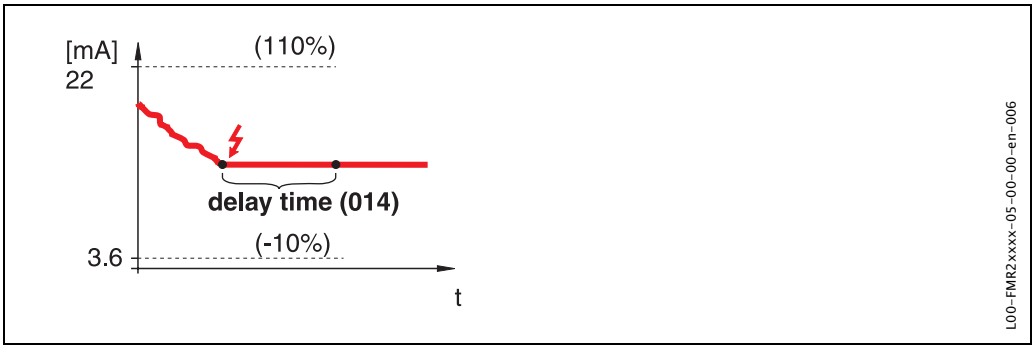
- alarm
- hold
- ramp %/min

**alarm**



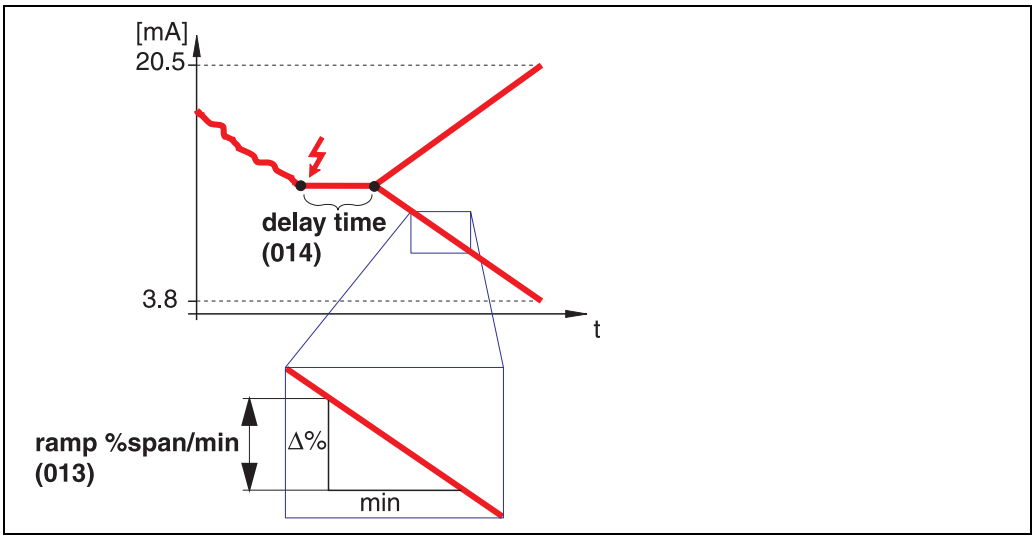

On echo loss, the instrument switches to alarm state after an adjustable "**delay time**" **(014)**. The output response depends on the configuration set in "**output on alarm**" **(010)**.

**hold**



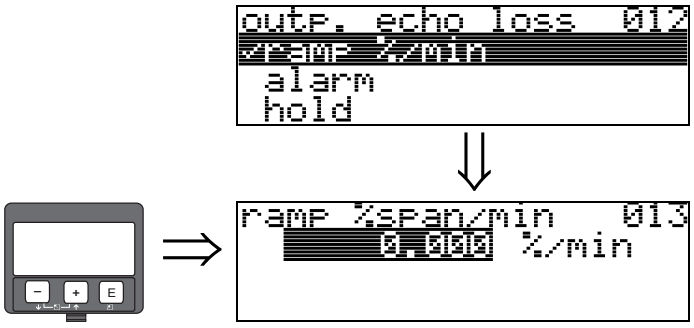

On echo loss, a warning is generated after a definable "**delay time**" **(014)**. Output is held.

**ramp %/min**



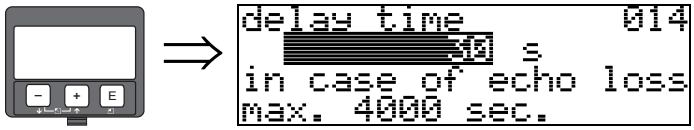

On echo loss, a warning is generated after a definable "**delay time**" **(014)**. The output is changed towards 0% or 100% depending on the slope defined in "**ramp %span/min**" **(013)**.

## 5.4 Function "ramp %span/min" (013)




Ramp slope which defines the output value on echo loss. This value is used if "**ramp %span/min**" is selected in "**outp. echo loss**" **(012)**. The slope is given in % of the measuring range per minute.

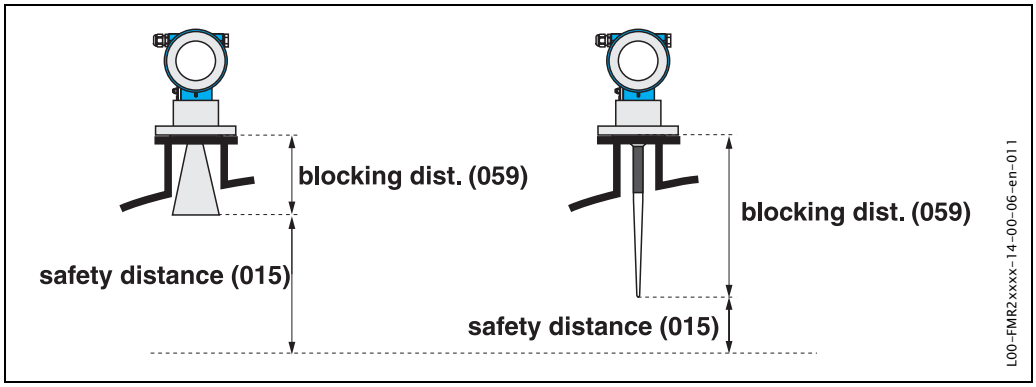
## 5.5 Function "delay time" (014)




Use this function to enter the delay time (Default = 30 s) after which a warning is generated on echo loss, or after which the instrument switches to alarm state.

## 5.6 Function "safety distance" (015)

A configurable safety distance is placed before the "**blocking dist.**" **(059)** (see page 59). This distance warns you that any further level increase would make the measurement invalid, for example, when bordering the antenna area.



Enter the size of the safety distance here. The default value is: 0.1 m.

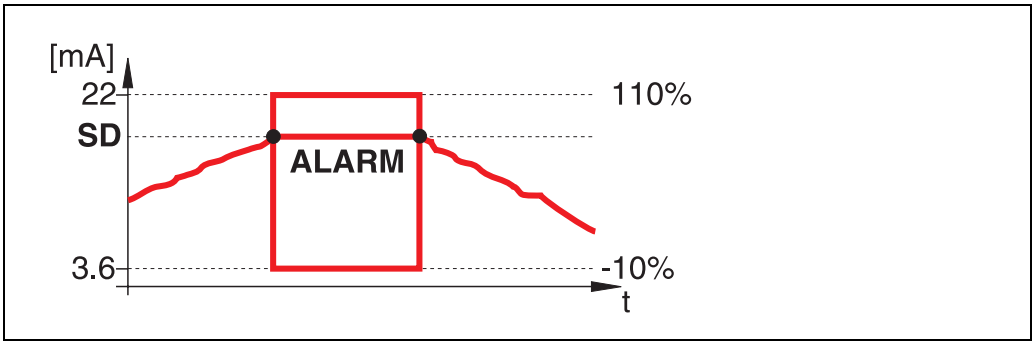
## 5.7 Function "in safety dist." (016)

This function defines the response when the level enters the safety distance .

**Selection:**

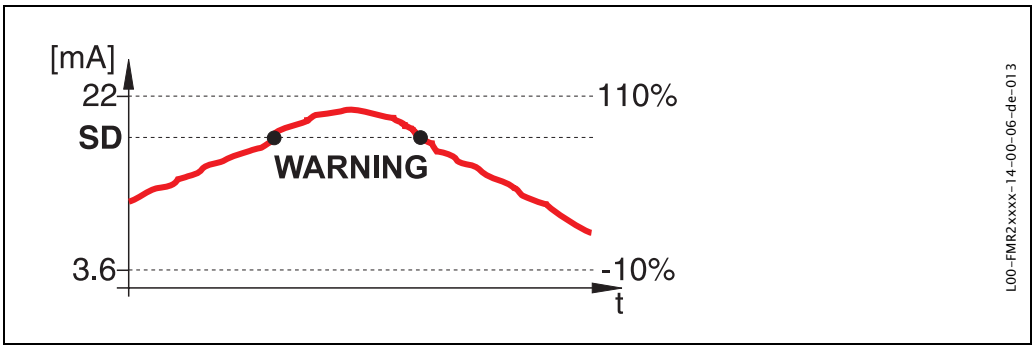
- alarm
- warning
- self holding

**alarm**



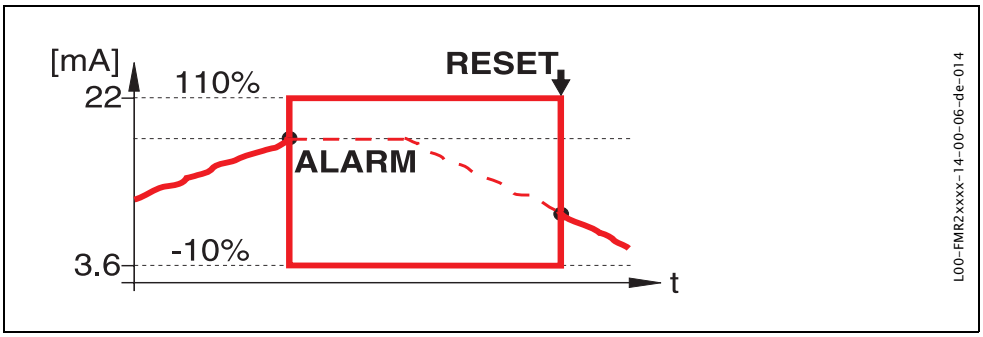

Instrument enters the defined alarm state ("**output on alarm**" **(011)**). The alarm message **E651** – "**level in safety distance – risk of overspill**" is displayed.
If the level drops out of the safety distance, the alarm warning disappears and the instrument starts to measure again.

**warning**




Instrument displays a warning **E651** – "**level in safety distance – risk of overspill**", but continues to measure. If the level leaves the safety distance, the warning disappears.

**self holding**




Instrument switches to defined alarm state ("**output on alarm**" **(011)**). The alarm message **E651** – "**level in safety distance – risk of overspill**" is displayed.
If the level leaves the safety distance, the measurement continues only after a reset of the self holding (function: "**ackn. alarm**" **(017)**).

## 5.8 Function "ackn. alarm" (017)

This function acknowledges an alarm in case of "**self holding**".

**Selection:**

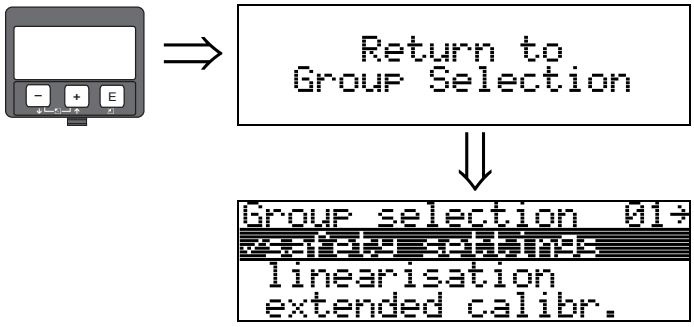
- no
- yes

**no**
The alarm is not acknowledged.

**yes**
Acknowledgement takes place.

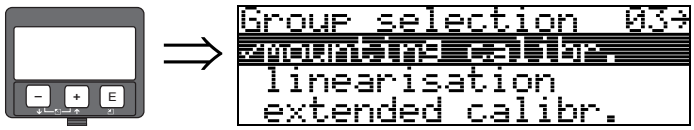
## 5.9 Function "overspill prot." (018)

When "**german WHG**" is selected, various parameters relating to WHG overflow protection are defaulted and the instrument is locked against further operation. Select "**Standard**" to unlock.




After 3 s, the following message appears

# 6 Function group "mounting calibr." (03)




## 6.1 Function "tank gauging" (030)

Using this function, you can either enter a dip table or carry out an auto-correction.

## 6.2 Function "auto correction" (031)

When measuring levels with radar systems, so-called "multipath reflections" can affect the level signal giving rise to serious measuring errors. "Multipath reflections" also include radar beams which are received by the radar system, which have not been reflected directly by the medium surface. They may reach the antenna via the basin wall and the medium surface. This phenomenon is particularly noticeable with devices mounted near to walls, as soon as the conical radar beam strikes the basin wall.
The 7500 RTG can automatically discover and correct measuring errors due to this "multiple path" propagation. This is because it uses two independent sets of information when evaluating reflection signals:

- Firstly, it evaluates the **amplitude** of the reflected energy using the so-called envelope curve system.
- Secondly, it evaluates the **phase** of the reflected energy.

The decisive factor for a constant output signal is to assign the phase values to the associated level values. This assignment is ensured using a correspondence table (index correction table). The 7500 RTG learns this for the specific application after installation (learning period).
Therefore, after mounting the device, and **after** completing the basic calibration, a **history reset** must be performed (enter "**yes**" in the "**history reset**" **(009)** function in the "**basic setup** " **(00)** function group).
Do not switch off the radar system during filling and emptying operations during the teach-in phase. Switching off when there are only negligible level changes produces no error.

**Caution!**
During the learning period, fast filling/emptying or turbulent surfaces can result in switching off and on the phase evaluation. Subsequently observed measurement errors will disappear as soon as tank levels come back to areas measured by 7500 RTG previously with activated phase evaluation. If the observed measurement errors are corrected by dip table entries, the 7500 RTG will take care of these corrections and automatically adjust the index correction table. Do NOT correct any settings in the basic calibration or the extended calibration.

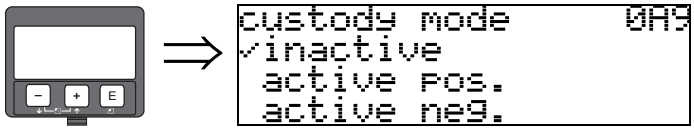
**Note!**
Immediately after installation, the 7500 RTG measures with the specified mm-accuracy. Until the level range has been completely covered by the medium (setting up the correction table), the maximum permissible filling speed is 100 mm level change / min. After this, the fill speed has no limitation.

## 6.3 Function "pipe diam.corr." (032) (only relevant for 7532 RTG)

For level measurement in stilling wells, radar systems require highly precise pipe inner diameter data. An mm-exact level measurement cannot be guaranteed for deviations from the actual stilling well inner diameter of more than ± 0.1mm to the value entered in the function group "**basic setup**" **(00)**. The errors which occur as a result are linear and can be corrected with a dip table containing at least two entries.
The 7500 RTG also has an automatic pipe inner diameter correction. This adjusts the entered stilling well inner diameter (input in the function group "**basic setup**" **(00)**) to the actual values. However, this presupposes that the value entered in the function group "**basic setup**" **(00)** matches the actual pipe inner diameter accurately as possible. The user-defined value entered in the function group "**basic setup**" **(00)** can be corrected with this value. In order to do this, switch on the "**pipe diam. corr.**" **(032)** function, after a level change **of at least 5 m** has occurred since start-up. The pipe diameter, which the instrument determines automatically, will then be transmitted to the "**pipe diameter**" **(007)** function.

**Note!**
Only if the "**pipe diameter**" **(007)** function has changed its value, it is necessary to perform a "**history reset**" **(009)** and to delete the dip table after activation of the "**pipe diam. corr.**" **(032)** function. Otherwise the level change of 5 m has not yet been exceeded. The "**pipe diam. corr.**" **(032)** function must be deactivated again and the procedure should be repeated at a later point of time.

### 6.3.1 Display "custody mode" (0A9)




This indicates the instrument calibration mode. The calibration mode (active) can be set using the hardware security lock on the electronics (see page 13).

**Selection:**

- inactive
- active pos.
- active neg.

**inactive**
The custody mode is not activated (switch for custody mode is open, see page 15)

**active pos.**
The custody mode (instrument is lead-sealed and accurate to the nearest mm) is active and is held.

**active neg.**
Custody mode (instrument is lead-sealed and accurate to the nearest mm) is activated and not held, e.g. because the signal-to-noise ratio is less than 10 dB (refer to "**echo quality**" **(056)** function in the "**extended calibr.**" **(05)** function group).

**Caution!**
After entering all the values and completing mounting and aligning work, enter the Reset Code "**555**" in the "**reset**" **0A3)** function to reset the instrument history for auto-correction.

## 6.4 Function "dip table mode" (033)

The dip table can be switched on or off using this function.

**Selection:**

- manual
- semi-automatic
- table on
- table off
- clear table
- view

**manual**
The value pairs in the dip table can be read and written. You can enter the measured value and the dip value.

-uncorrected measured value:
This is the measured value supplied by the instrument, **NOT** corrected by the dip table. The choice of measured value, level or remaining fill height is dependent on the instrument setting.

-Dip value:
This is the level or distance to flange respectively, given by the hand dip. This value should be used to correct the measured value.
The "manual mode" of the dip table can be used to enter collected data after a series of data pairs taken at different tank levels.

**Note!**
The bigger the distance between the different levels while taking hand dips, the more accurate the linearisation of the dip table will be.

**semi-automatic**
The value pairs in the dip table can be read. You can enter the dip value only. When there are new value pairs, the current level or distance is accepted as the measured value.

**table on**
The dip table is switched on.

**table off**
The dip table is switched off.

**clear table**
The complete dip table is deleted. The table is switched off. The number of free table entries is set to the maximum value (**= 32**).

**view**
The value pairs in the dip table can **only** be read. You can still select this menu option, even if there is no dip table available. In this case, the number of free table entries is at maximum value (**= 32**).

### 6.4.1 Dip table

The dip table is used to correct the level readings of the 7500 RTG using independently taken hand dips. The dip table is used in particular to adapt the level gauge to the specific application conditions as mechanical offset and tank/stilling well design. Depending on national regulations, national inspectors will dip the tank at one to three levels during a calibration run and check the level readings.
Only one value pair must be entered into the dip table to correct the measurement **offset**.
If a second value pair is entered into the dip table, the 7500 RTG accepts the corrected measured values identically for both value pairs. All other measured values are determined by linear extrapolation.
If you enter more than two value pairs, the system carries out a linear interpolation between adjacent value pairs. Outside these value pairs, extrapolation is also linear.

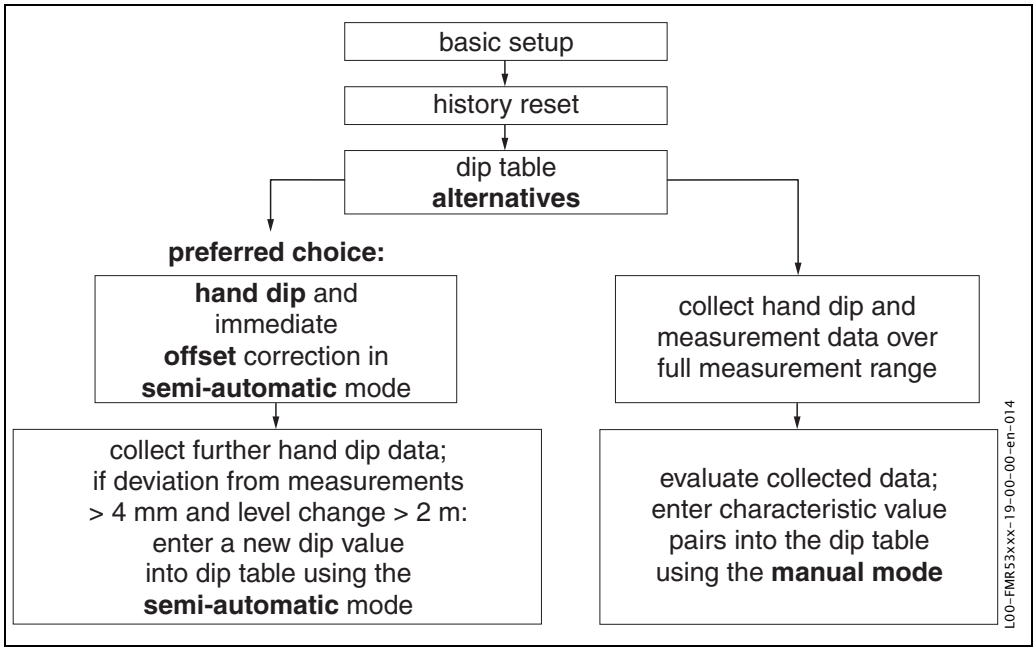



Figure 4: Alternative procedures to fill the dip table.

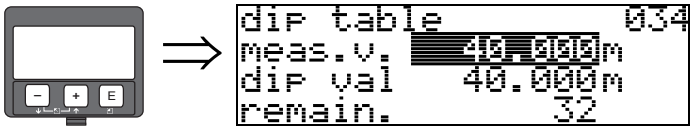
To collect and enter data into the dip table, two alternative procedures may be carried out. In order not to mix up measurement values corrected by the offset or linearisation of the dip table with uncorrected measurement values, it is recommended to use the semi-automatic mode of the dip table to enter new data pairs. In this case, the first dip value should be entered immediately after the basic calibration. Further linearisation points should be entered only after a level change of at least 2 m (cf. Figure 4:, preferred choice) and a deviation between the "uncorrected measurement value" and the hand dip value of at least 4mm.
If this procedure can not be followed, then **NO** value pair should be entered into the dip table after basic calibration. Measurement data and hand dip values should be collected over the full measurement range and be evaluated with regard to a good linear fit. Only then characteristic value pairs should be entered into the dip table using the "manual mode" (cf. Figure 4:, right side). If further linearisation is needed, further hand dip values should be entered **using only the "semi-automatic mode"**.

**Note!**
The dip table can be printed out using the ToF-Tool.

**Note!**
Make your inputs into the dip table in semi-automatic mode. We advise you to leave "**auto correction**" **(031)** activated ("on") while you enter your inputs.

**Caution!**
After entering one or more points into the dip table, make sure that the dip table is activated and left in the "**table on**" dip table mode.

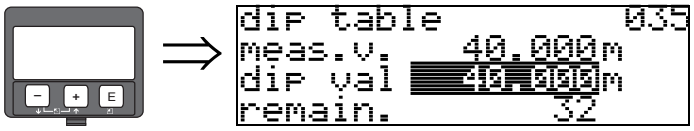
## 6.5 Function "dip table" (034)




This function edits measured variable. The number behind the entry "**remain**" indicates the current number of remaining free value pairs. The maximum number of value pairs is 32; after each entry, the remaining number is decremented.

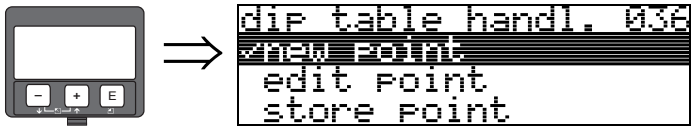
**Note!**
The uncorrected measured value is displayed in the "**dip table**" (034) function. This may differ considerably from the measured values when a dip table is activated.

## 6.6 Function "dip table" (035)




This function edits the dip value.

## 6.7 Function "dip table handl." (036)




Use this function to enter the dip value (level or distance) which will correct the measurement values.

**Selection:**

- new point
- edit point
- store point
- delete point
- return
- next point
- previous point

**General procedure:**
To enter a new point into the dip table, use
"**new point**" to enter the value (pairs) ,
"**store point**" to sort the new value (pairs)
"**return**" to go to the dip table mode and
"**table on**" to activate the dip table.

**new point**
You can enter a new point. A suggested value is displayed for the measured variable, the dip value of the current level or the distance. With semi-automatic inputs, the current level or the current remaining fill height is displayed as proposed dip value. The new value pair can be altered without selecting the
"**edit point**" parameter.
If the table is full, you can still select this parameter. In this case, the number of free table entries stands at minimum value (**= 0**).

**edit point**
The displayed value pair can be changed. Only the dip value can be changed with semi-automatic input mode.

**Caution!**
To accept the value pair in the table, confirm it with "**store point**".

**store point**
The displayed value pair is sorted in the table.

**Note!**
For sorting, the following criteria must be met:

- Measured variables may not be equal but have different dip values.
- A measured variable available in the table is recognized as equal when it is closer than 1 mm to the sorting value.
- After successful sorting, the setting remains at "**edit point**" and the number of free table entries is decremented.

**Caution!**
If the value cannot be sorted, the setting remains at the previous menu option. No warning or error message is generated. However, the number of remaining table entries is not decremented.

**delete point**
The currently displayed point is deleted from the table. After deletion, the previous point is displayed. If the table only consisted of one point before deletion, then the current measured variable is displayed as a value pair.

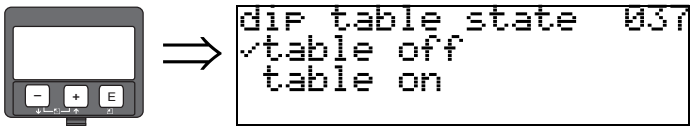
**return**
By selecting this point, you return to the function "**dip table mode**" **(033)**.

**next point**
This scrolls down in the table. If the table is empty, you can still select this option. However, the displayed value does not change.

**previous point**
This scrolls up in the table. If the table is empty, you can still select this option. However, the displayed value does not change.

**Caution!**
After entering one or more points into the dip table, make sure that the dip table is activated in the "**table on**" dip table mode.

## 6.8 Function "dip table state" (037)




This function displays the dip table status.

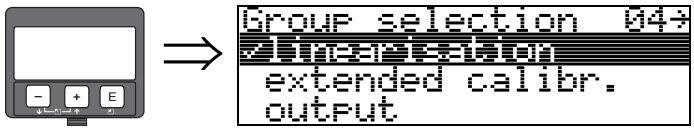
**Display:**

- table on
- table off

**table on**
Indicates whether the dip table is active.

**table off**
Indicates whether the dip table is not active.

# 7 Function group "linearisation" (04)




## 7.1 Function "level/ullage" (040)

**Selection:**

- level CU
- level DU
- ullage CU
- ullage DU

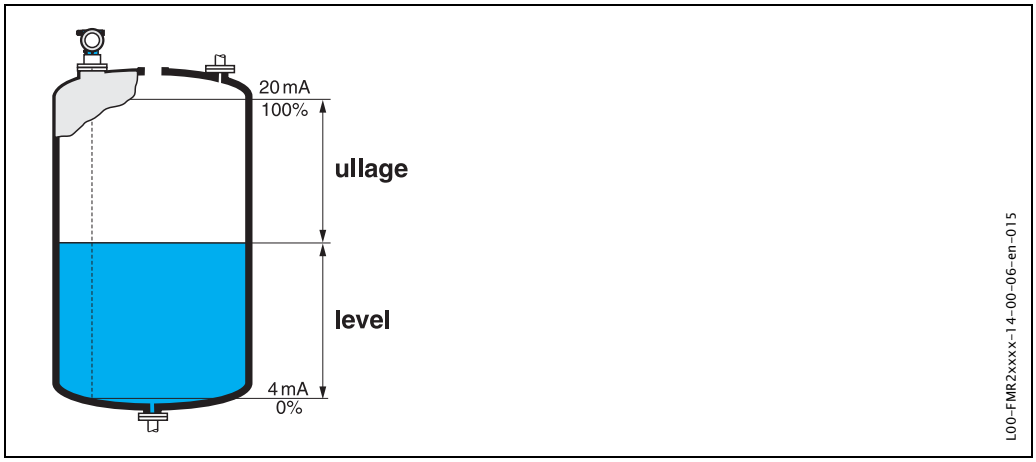
**level CU**
Level in customer units. The measured value can be linearised.
The "**linearisation**" **(041)** default value is set to a linear 0...100%.

**level DU**
Level in the selected "**distance unit**" **(0C5)**.

**ullage CU**
Ullage in customer units. The value can be linearised.
The "**linearisation**" **(041)** default value is set to a linear 0...100%.

**ullage DU**
Ullage in the selected "**distance unit**" **(0C5)**.

**Note!**
Reference point for the ullage is "full calibr." (=span).



## 7.2 Function "linearisation" (041)

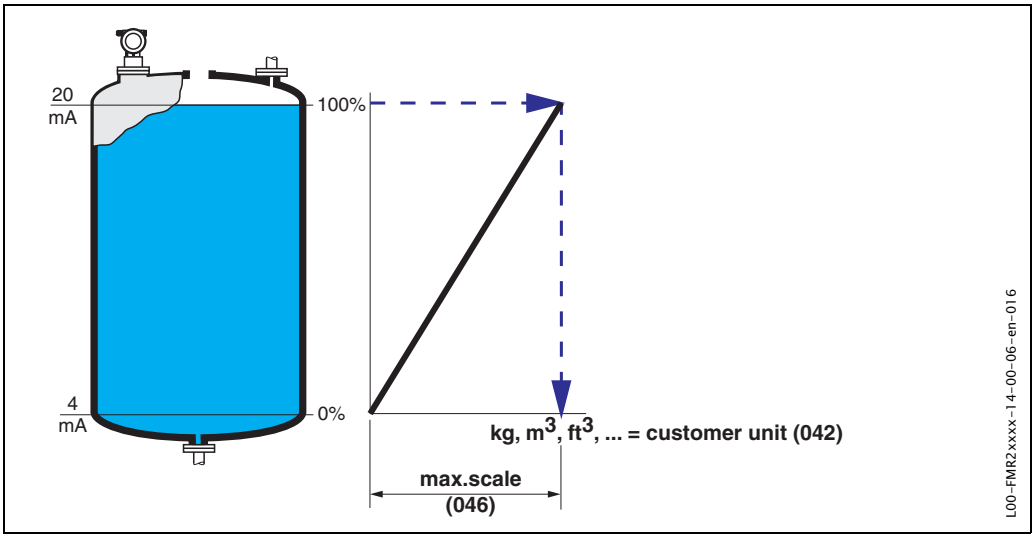
Linearisation defines the ratio of level to container volume or product weight and allows a measurement in customer units, e.g. metres, hectolitres etc. The measured value in (000) is then displayed in the selected unit.

This function is used to select the linearisation modes.

**Selection:**

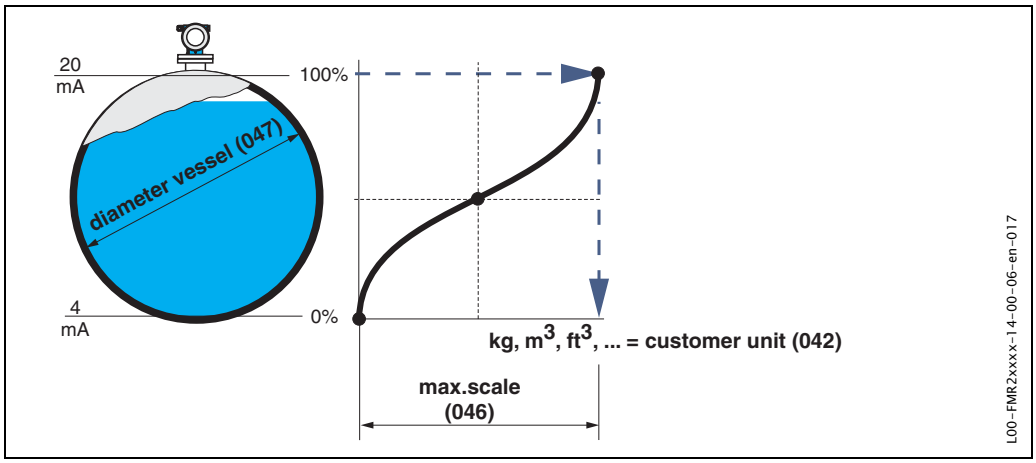
- linear
- horizontal cyl
- manual
- semi-automatic
- table on
- clear table

**linear**
The tank is linear e.g. a cylindrical vertical tank. You can measure in customer units by entering a maximum volume/weight.
You can select the "**customer unit**" **(042)**. Define the volume value corresponding to the calibration in "**max. scale**" **(046)**. This value corresponds to an output of 100% (= 20 mA for HART).



**horizontal cyl**

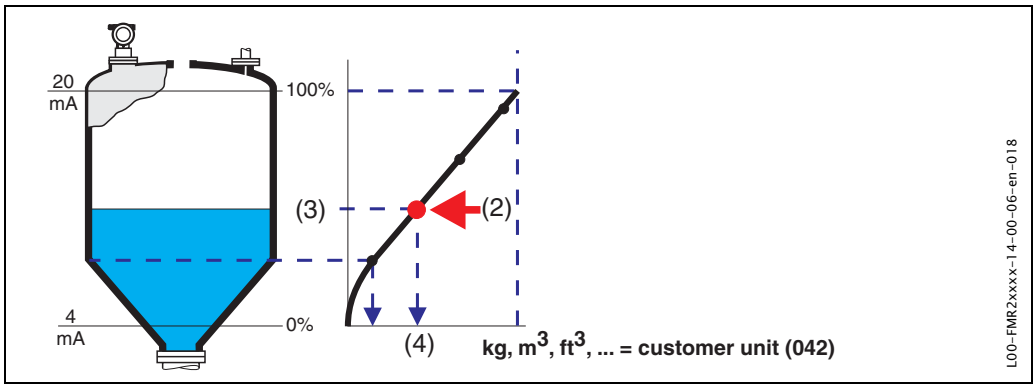
The volume, mass etc. are calculated automatically in cylindrical horizontal tanks by entering the "**diameter vessel" (047)**, the "**customer unit" (042)** and the "**max. scale" (046)**. The "**max. scale" (046)** corresponds to an output of 100% (= 20 mA for HART).




**manual**

If the level is not proportional to the volume or weight within the set measuring range, you can enter a linearisation table in order to measure in customer units. The requirements are as follows:

- The 32 (max.) value pairs for the linearisation curve points are known.
- The level values must be given in ascending order. The curve is monotonously increasing.
- The level heights for the first and last points on the linearisation curve correspond to empty and full calibration respectively.
- The linearisation takes place in the basic setup unit ("**distance unit" (0C5)**).

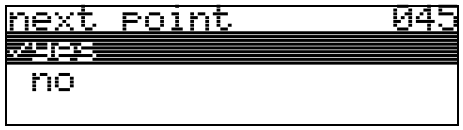



Each point (2) in the table is described by a value pair: level (3) and, for example, volume (4). The last value pair defines the 100% output (= 20 mA for HART).

Select the table point (Point 1).

Enter the level belonging to Point 1.

Enter the corresponding volume.




Enter a further table point?

Next table point.

...

Continue until "**next point**" **(045)** is answered with no.

**Note!**
After making entries into the table, activate it with "**table on**".
The 100% value (=20 mA for HART) is defined by the last point in the table.

**Note!**
Before confirming 0.00 m as the level or 0.00% as the volume, activate the Edit mode with [+] or [−].

Entries can be made into the linearisation table in ToF Tool using the table editor. You can also display the contents graphically.

**semi-automatic**
The tank is filled in stages when the linearisation curve is entered semi-automatically. The 7500 RTG automatically detects the level and the corresponding volume/weight has to be entered.
The procedure is similar to manual table entry, where the level value for each table point is given automatically by the instrument.

**Note!**
If the tank is emptied (out litres), pay attention to the following points:

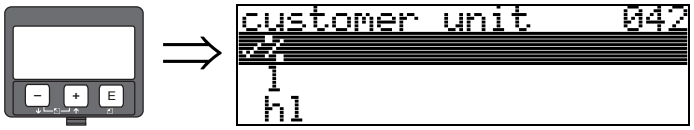
- The number of points must be known in advance.
- The first table number = (32 – number of points).
- Entries in "**Tab. no.**" **(043)** are made in reverse order (last entry = 1).

**table on**
An entered linearisation table only becomes effective when activated.

**clear table**
Before making entries into the linearisation table, any existing tables must be deleted. The linearisation mode automatically switches to linear.

**Note!**
A linearisation table can be deactivated by selecting "**linear**" or "**horizontal cyl**" (or the "**level/ullage**" **(040)** function = "**level DU**", "**ullage DU**"). It is not deleted and can be reactivated at any time by selecting "**table on**".

## 7.3 Function "customer unit" (042)




You can select the customer unit with this function.

**Selection:**

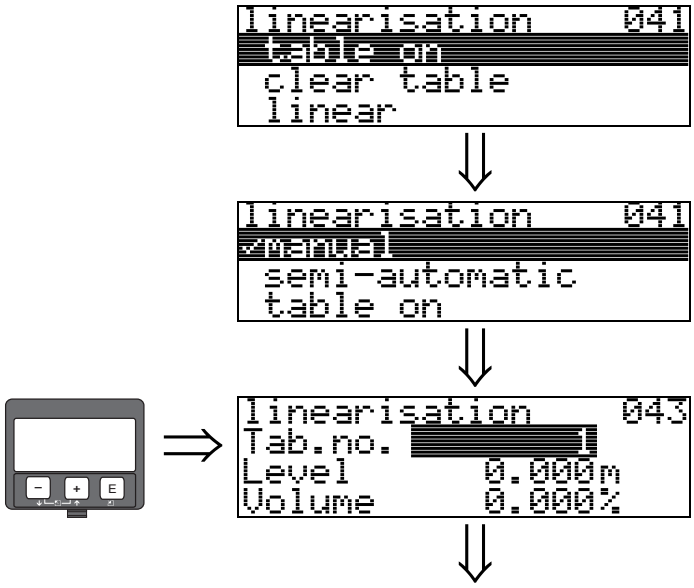
- %
- l
- hl
- m3
- dm3
- cm3
- ft3
- us_gal
- i_gal
- kg
- t
- lb
- ton
- m
- ft
- mm
- inch

**Dependence**

The units of the following parameters are changed:

- measured value (000)
- input volume (045)
- max. scale (046)
- simulation value (066)

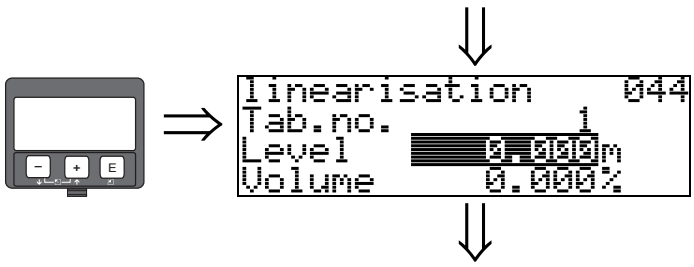
## 7.4 Function "table no." (043)




Position of the value pair in the linearisation table.

**Dependence**
Updates "**input level**" **(044)** , "**input volume**" **(045)**.

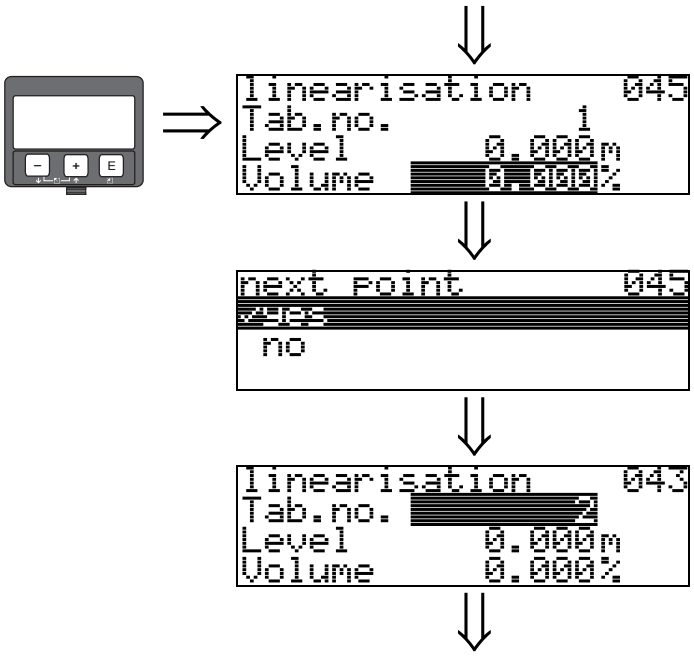
## 7.5 Function "input level" (044)




You can enter the level for each point of the linearisation curve with this function. When the linearisation curve is entered semi-automatically, the 7500 RTG detects the level automatically.

**User input:**
Level in "**distance unit**" **(0C5)**.

## 7.6 Function "input volume" (045)



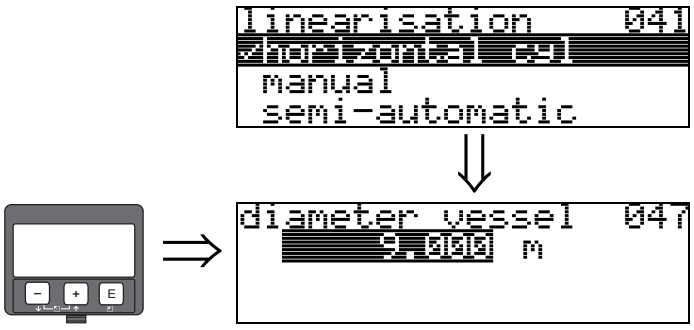

Specify the volume for each point of the linearisation curve with this function.

**User input:**
Volume in "**customer unit**" **(042)**.

## 7.7 Function "max. scale" (046)

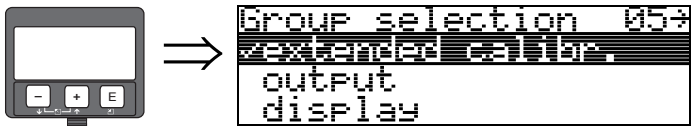
You can enter the end value of the measuring range with this function. This input is necessary if you selected "**linear**" or "**horizontal cyl**" in the "**linearisation**" **(041)** function.

## 7.8 Function "diameter vessel" (047)

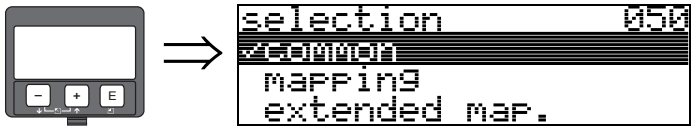



Enter the tank diameter with this function. This entry is necessary if you selected "**horizontal cyl**" in the "**linearisation**" **(041)** function.

# 8 Function group "extended calibr." (05)




## 8.1 Function "selection" (050)




Select the function of the extended calibration.

**Selection:**

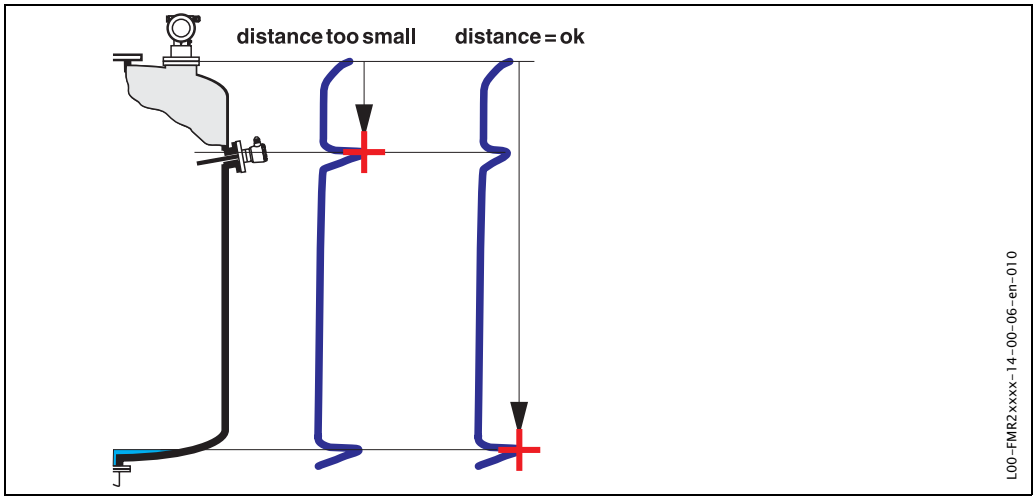
- **common** (e.g. "Level correction", "Output damping", etc.)
- mapping
- extended map.

## 8.2 Function "check distance" (051)

This function triggers the mapping of interference echoes. To do so, the measured distance must be compared with the actual distance to the product surface. The following options are available for selection:

**Selection:**

- distance = ok
- dist. too small
- dist. too big
- dist. unknown
- manual



**distance = ok**

- mapping is carried out up to the currently measured echo
- The range to be suppressed is suggested in the "**range of mapping (052)**" function

Anyway, it is wise to carry out a mapping even in this case.

**dist. too small**

- At the moment, an interference is being evaluated
- Therefore, a mapping is carried out including the presently measured echoes
- The range to be suppressed is suggested in the "**range of mapping (052)**" function

**dist. too big**

- This error cannot be remedied by interference echo mapping
- Check the application parameters **(002), (003), (004)** and "**empty calibr.**" **(005)**

**dist. unknown**
If the actual distance is not known, no mapping can be carried out.

**manual**
A mapping is also possible by manual entry of the range to be suppressed. This entry is made in the "**range of mapping (052)**" function.

**Caution!**
The range of mapping must end 0.5 m (20") before the echo of the actual level. For an empty tank, do not enter E, but E – 0.5 m (20").

## 8.3 Function "range of mapping" (052)

This function displays the suggested range of mapping. The reference point is always the reference point of the measurement (see page 2). This value can be edited by the operator.
For manual mapping, the default value is: 0 m.

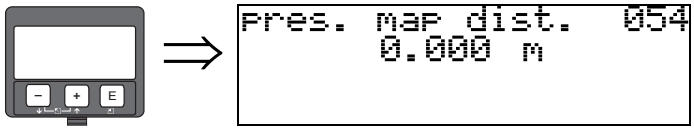
## 8.4 Function "start mapping" (053)

This function is used to start the interference echo mapping up to the distance given in "**range of mapping**" **(052)**.

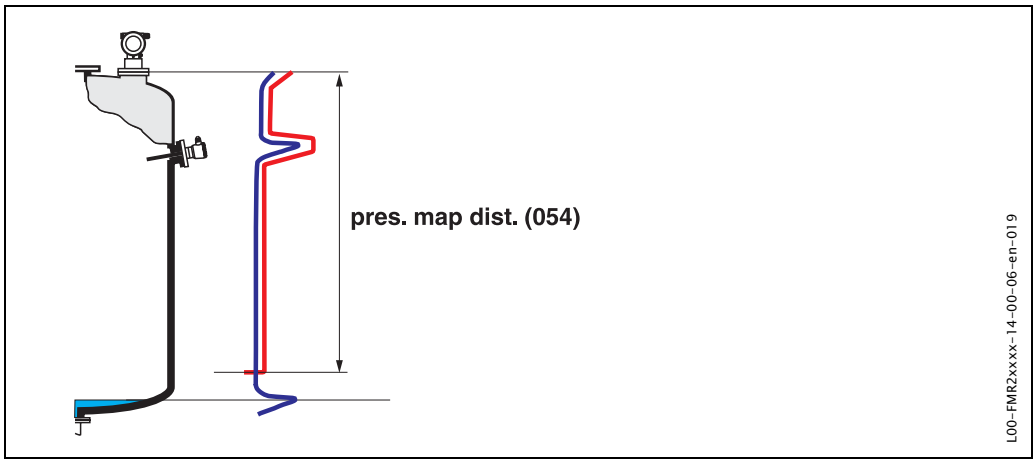
**Selection:**

- **off**: no mapping is carried out
- on: mapping is started

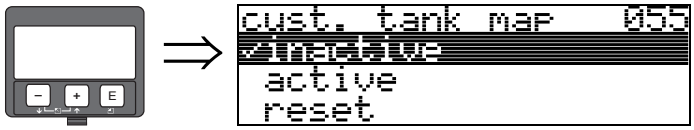
## 8.5 Function "pres. map dist." (054)




Displays the distance up to which a mapping has been recorded.
A value of 0 indicates that no mapping was recorded so far.




## 8.6 Function "cust. tank map" (055)




This function displays the evaluation mode using the customer tank map.

**Selection:**

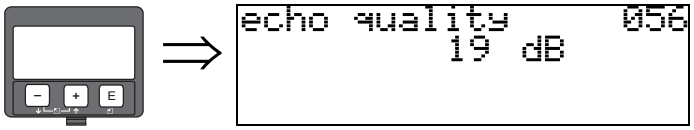
- inactive
- active
- reset

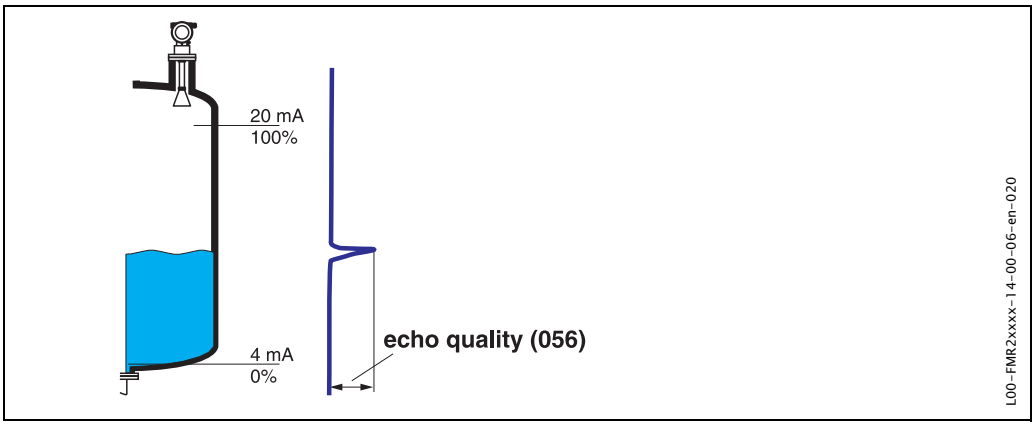
**inactive**
No tank mapping has been recorded, or map is switched off. Evaluation is only using FAC (see page 88).

**active**
Evaluation is using the customer tank map (see page 87).

**reset**
Deletes the complete tank map.

## 8.7 Function "echo quality" (056)




The echo quality is the benchmark for measurement reliability. It describes the amount of reflected energy and depends primarily on the following conditions:

- Dielectric constant of the medium
- Surface characteristics (waves, foam etc.)
- Distance between sensor and product

Low values increase the probability that the echo is lost through a change in measurement conditions, e.g. turbulent surface, foam, large measuring distance.

**Caution!**
Echo quality can be improved by orientation of the 7500 RTG (see page 95).

## 8.8 Function "offset" (057)

This function corrects the measured level by a constant value. The entered value is added to the measured level.
This function is primarily used for runtime correction when using an FAR 10 antenna extension with 7530 RTG.

offset (m) = 0.395 * length of the FAR 10 in m

For the standard lengths of the FAR10, this results in:

| | Length of the FAR 10 | | | |
|---|---|---|---|---|
| | 100 mm (4") | 200 mm (8") | 300 mm (12") | 400 mm (16") |
| **Correction value [m]** | 0.0395 | 0.0790 | 0.1185 | 0.1580 |

## 8.9 Function "output damping" (058)

Influences the time an output requires to react to a sudden level jump (63% of steady state). A high value attenuates, for example, the influences of rapid changes on the measured variable.

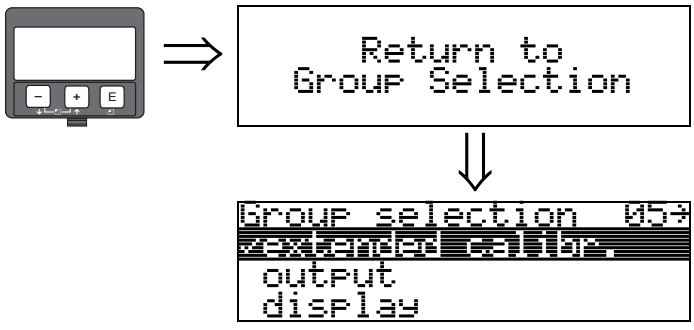
**User input:**
0...255 s

The default value depends on the selected application parameters "**tank shape**" **(002)**, "**medium property**" **(003)** and "**process cond.**" **(004)**.

## 8.10 Function "blocking dist." (059)

A window below the antenna tip can be suppressed when there are strong reflections near the antenna of structures, welding joints or struts.

- The blocking distance is measured from the bottom edge of the process connection. Usually, the suppression reaches up to the tip of the antenna (see diagram on page 35).
- All echos are suppressed within this blocking distance.
- As the level echo could possibly be suppressed (and there is no guarantee that no other significant echo is available), a 10 cm long safety distance is placed in front of the suppression (see "**safety distance**" **(015)** function on page 35).
- The customer can set the 7500 RTG to respond to circumstances when the product is within this zone (safety distance) (see page 35).




After 3 s, the following message appears

# 9 Function group "output" (06)

Display at HART instrument

## 9.1 Function "commun. address" (060)

Enter the communication address for the instrument with this function.

- Stand alone version: 0; output current 4...20 mA
- Standard: 1
- Multidrop: 1–15

The output current is constant at 4mA in multidrop mode.

## 9.2 Function "no. of preambels" (061)

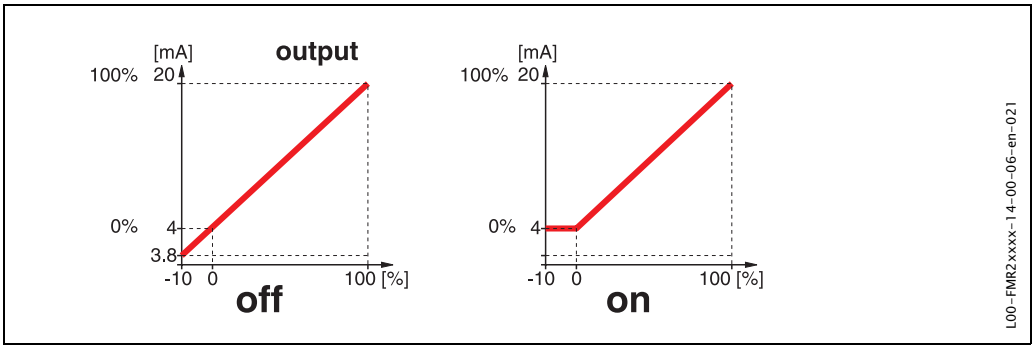
Enter the number of preambles for the HART protocol with this function.
An increase in the value is advisable for "bad" lines with communications problems.

## 9.3 Function "thres. main val." (062)

The output of negative level values can be suppressed with this function.

**Selection:**

- offminimum output –10% (3.8 mA for HART)
- **on**minimum output 0% (4 mA for HART)

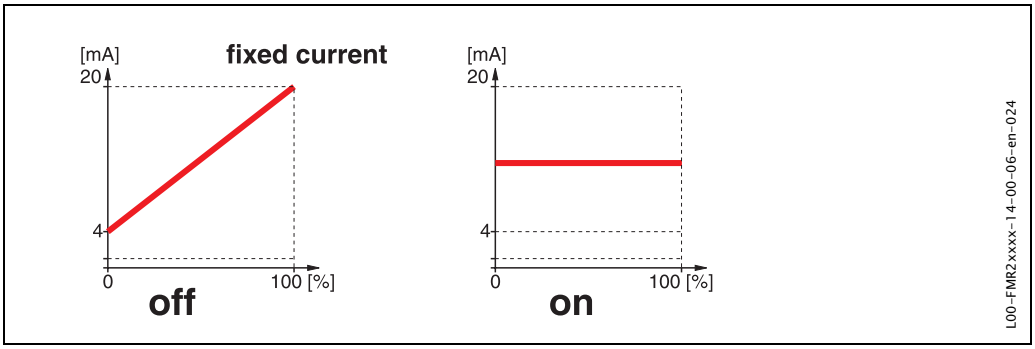



## 9.4 Function "fixed current" (063)

You can fix the output current to a configurable value with this function.
The measured value is transferred via HART.

**Selection:**

- off
- on

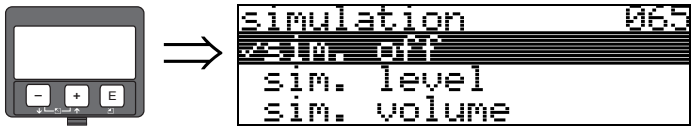


## 9.5 Function "fixed cur. value" (064)

Set the fixed current value with this function. This entry is necessary when you have switched on the "**fixed current**" **(063)** function.

**User input**:
3,8...20,5 mA

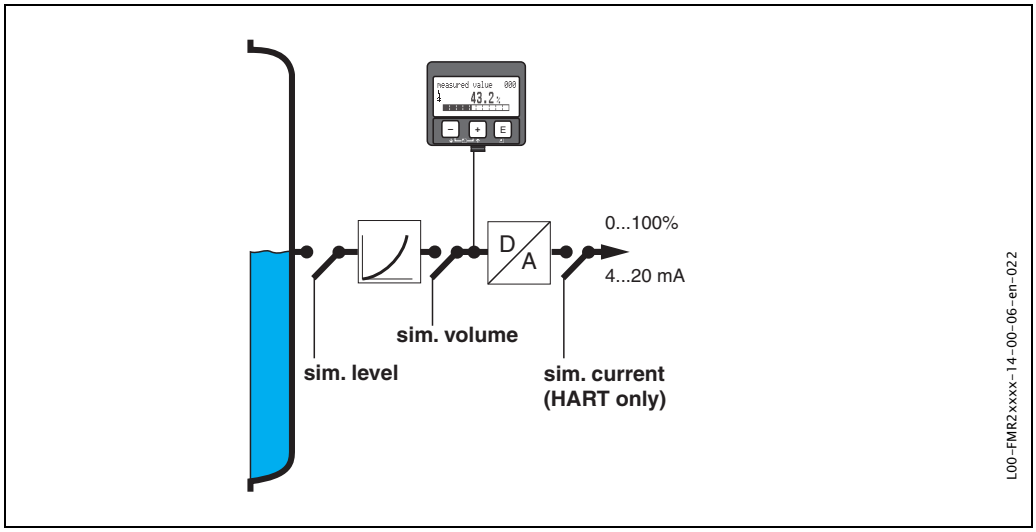
## 9.6 Function "simulation" (065)




If necessary, linearisation, the output signal and the current output can be tested with the simulation function. You have the following simulation options:

**Selection:**

- sim. off
- sim. level
- sim. volume
- sim. current (HART only)




**sim. off**
Simulation is switched off.

**sim. level**
Enter the level value in "**simulation value**" **(066)**.
The functions

- measured value (000)
- measured level (0A6)
- output current" (067) – only with HART instruments!

follow the entered values.

**sim. volume**
Enter the volume value in "**simulation value**" **(066)**.
The functions

- measured value (000)
- output current" (067) – only with HART instruments!

follow the entered values.

**sim. current (HART only)**
Enter the current value in "**simulation value**" **(066)**.
The function

- output current" (067) – only with HART instruments!

follows the entered values.

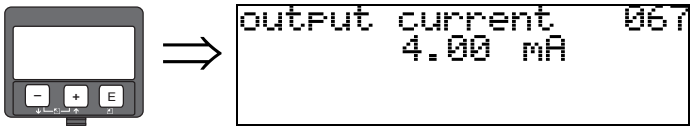
## 9.7 Function "simulation value" (066)

After selecting the "**sim. level**" option in the "**simulation**" **(065)** function, the following message appears in the display: you can enter the level.

After selecting the "**sim. volume**" option in the "**simulation**" **(065)** function, the following message appears in the display: you can enter the volume.

After selecting the "**sim. current**" option in the "**simulation**" **(065)** function, the following message appears in the display: Enter the output current (only for HART instruments).

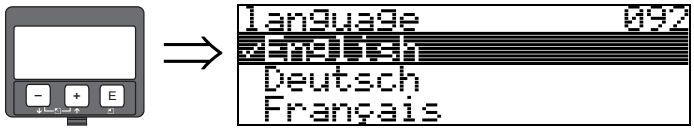
## 9.8 Function "output current" (067)




Displays the output current in mA.

# 10 Function group "display" (09)

## 10.1 Function "language" (092)




Selects the display language.

**Selection:**

- English
- Deutsch
- Français
- Español
- Italiano
- Nederlands

**Dependence**
All texts are changed.

**Caution!**
This function is not visualised in Commuwin II!

## 10.2 Function "back to home" (093)

If no entry is made using the display during the specified time period, the display returns to the measured value display.
0 s means that there is no return.

**User input:**
0...9999 s

**Caution!**
This function is not visualised in Commuwin II!

## 10.3 Function "format display" (094)

Selects the display format.

**Selection:**

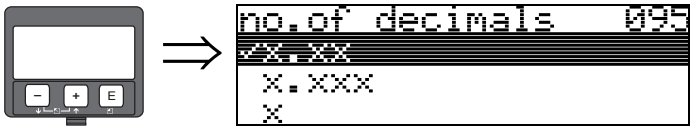
- decimal
- 1/16"

**decimal**
The measured value is given in decimal form in the display (e.g. 10.70%).

**1/16"**
The measured value is given in the display in this format (e.g 5'05-14/16").
This option is only possible for "**distance unit**" **(0C5)** – "**ft**" and "**in**"!

**Caution!**
This function is not visualised in Commuwin II!

## 10.4 Function "no.of decimals" (095)




**Selection:**

- x
- x.x
- x.xx
- x.xxx
- x.xxxx

## 10.5 Function "sep. character" (096)

**Selection:**

- .
- ,

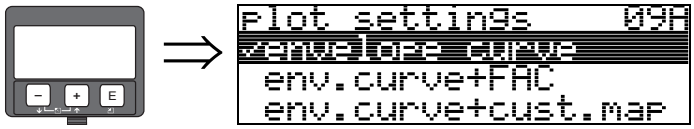
**.**
The decimal place is separated by a point.

**,**
The decimal place is separated by a comma.

## 10.6 Function "display test" (097)

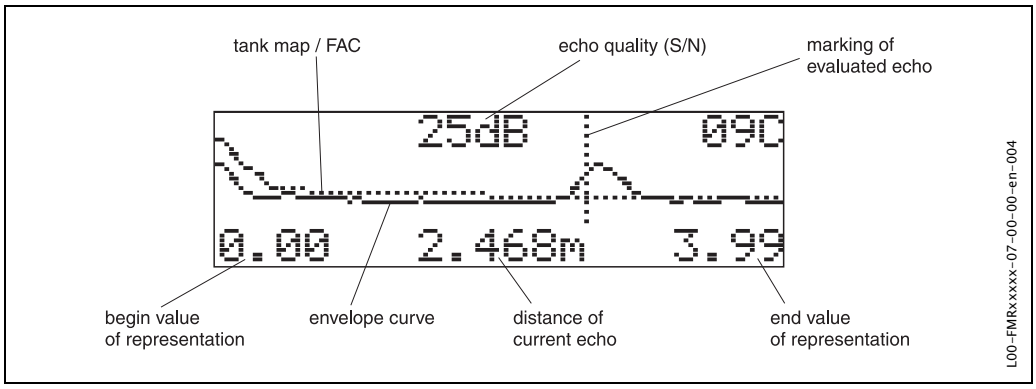
All display pixels are switched on. If the whole LCD is dark, it is working correctly.

## 10.7 Function "plot settings" (09A)




Here select which information is displayed in the LCD:

- envelope curve
- env.curve+FAC (on FAC see page 88)
- env.curve+cust.map (i.e. customer tank map is also displayed)




## 10.8 Function "recording curve" (09B)

This function defines whether the envelope curve is read as a

- **single curve**

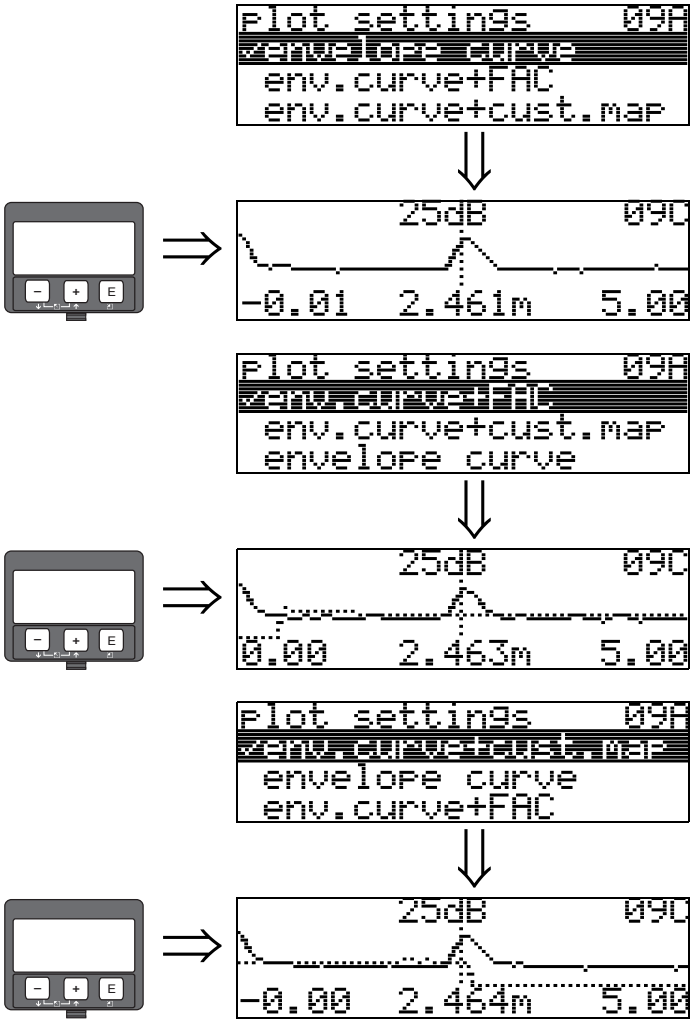
  or
- cyclic.

**Note!**
If the cyclical envelope curve is active in the display, the measured variable is refreshed in a slower cycle time. It is therefore recommended to exit the envelope curve display after optimising the measuring point.

**Note!**
An **orientation** of the 7500 RTG can help to optimise measurement in applications with very weak level echos or strong interference echos by increasing the useful echo/ reducing the interference echo (see»Orientation of the 7500 RTG« on page 95).

## 10.9 Function "envelope curve" (09C)

This functions shows the envelope curve in the display. The form shown is dependent on the settings in the "**plot settings**" **(09A)** function.



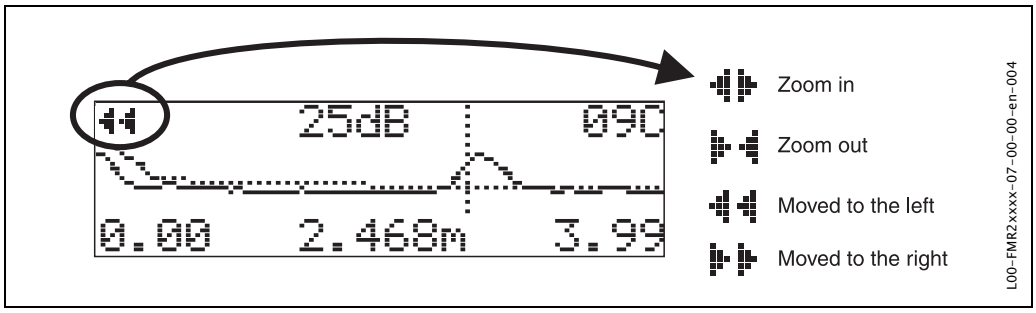

Show envelope curve.

Show envelope curve + FAC (Floating Average Curve).

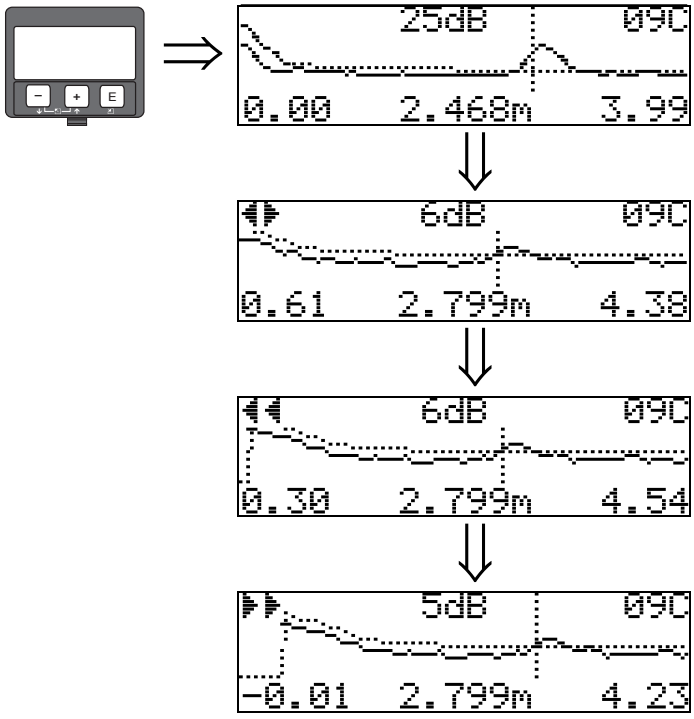
Show envelope curve + tank map.

## 10.10 Envelope curve - navigate mode

In the envelope curve navigation mode , you can zoom in/out the curve (Zoom mode) or move it left or right.
The active mode is indicated by a symbol in the top left-hand corner of the display.




**Operation:**




[+] or [−] : switch to Zoom mode.
[+] Zoom in -> is shown.
[−] Zoom out -> is shown.

**Zoom mode!**

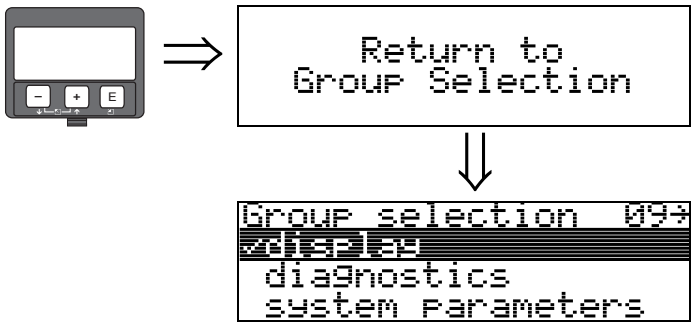
[E] Switch to Move mode.

**Move mode!**

[+] moves the curve to the right -> is shown.
[−] moves the curve to the left -> is shown.

**Move mode, curve moved to the right.**

[E] : Toggle between Move and Zoom modes.
[−] [+] : Exit Navigation mode.




After 3 s, the following message appears

# 11 Function group "diagnostics" (0A)

In the "**diagnostics**" function group, you can display and confirm error messages.

### Type of error

Errors that occur during commissioning or measuring are displayed immediately on the local display. If two or more system or process errors occur, the error with the highest priority is the one shown on the display.
The measuring system distinguishes between two types of error:

- **A (Alarm):**
  Instrument goes into a defined state (e.g. MAX)
  Indicated by a constant ϟ symbol.
  (For a description of the codes, see Table 15.2 on Page 91)
- **W (Warning):**
  Instrument continue measuring, error message is displayed.
  Indicated by a flashing ϟ symbol.
  (For a description of the codes, see Table 15.2 on Page 91)
- **E (Alarm / Warning):**
  Configurable (e.g. loss of echo, level within the safety distance)
  Indicated by a constant/flashing ϟ symbol.
  (For a description of the codes, see Table 15.2 on Page 91)

### Error messages

Error messages appear as four lines of plain text on the display. In addition, a unique error code is also output. A description of the error codes is given on page 91.

- The "**diagnostics (0A)**" function group can display current errors as well as the last errors that occurred.
- If several current errors occur, use [+] or [−] to page through the error messages.
- The last occurring error can be deleted in the "**diagnostics (0A)**" function group with the function "**clear last error**" **(0A2)**.

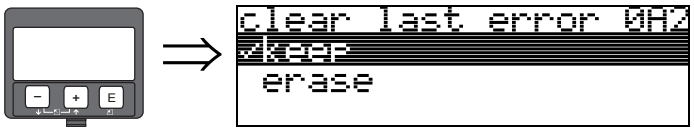
## 11.1 Function "present error" (0A0)

The present error is shown using this function.

## 11.2 Function "previous error" (0A1)

The last error presented is shown with this function.

## 11.3 Function "clear last error" (0A2)




**Selection:**

- keep
- erase

**Caution!**
This function can be performed on the display only!

## 11.4 Function "reset" (0A3)

**Caution!**
A reset sets the instrument back to the factory settings. This can lead to an impairment of the measurement. Generally, you should perform a basic setup again following a reset.

A reset is only necessary:

- if the instrument no longer functions
- if the instrument must be moved from one measuring point to another
- if the instrument is being de-installed /put into storage/installed

**Entry ("reset" (0A3)):**

- 333 = customer parameters
- 555 = history reset

**333 = reset customer parameters**
This reset is recommended whenever an instrument with an unknown 'history' is to be used in an application:

- The 7500 RTG is reset to the default values.
- The customer specific tank map is not deleted.
- A linearisation is switched to "**linear**" although the table values are retained. The table can be reactivated in the "**linearisation**" **(04)** function group.

List of functions that are affected by a reset:

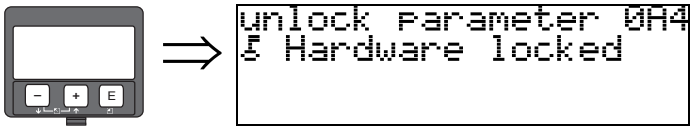
- tank shape (002)
- empty calibr. (005)
- full calibr. (006)
- pipe diameter (007)
- output on alarm (010)
- output on alarm (011)
- outp. echo loss (012)
- ramp %span/min (013)
- delay time (014)
- safety distance (015)
- in safety dist. (016)
- level/ullage (040)
- linearisation (041)
- customer unit (042)
- diameter vessel (047)
- range of mapping (052)
- pres. Map dist (054)
- offset (057)
- low output limit (062)
- fixed current (063)
- fixed cur. value (064)
- simulation (065)
- simulation value (066)
- format display (094)
- distance unit (0C5)
- download mode (0C8)

**555 = History Reset**
After mounting and aligning the equipment, carry out a history reset before switching on the "**auto correction**" **(031)** function (see page 39).

The tank map can also be reset in the "**cust. tank map**" **(055)** function of the "**extended calibr.**" **(05)** function group.
This reset is recommended whenever an instrument with an unknown 'history' is to be used in an application or if a faulty mapping was started:

- The tank map is deleted. The mapping must be recommenced.

## 11.5 Function "unlock parameter" (0A4)



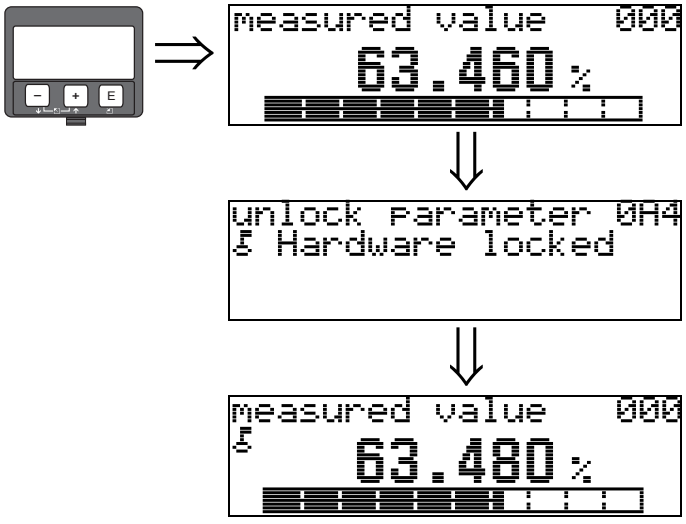

Set-up can be locked and unlocked with this function.

### 11.5.1 Locking of the configuration mode

The 7500 RTG can be protected in two ways against unauthorized changing of instrument data, numerical values or factory settings:

"**unlock parameter**" **(0A4):**
A value **<> 100 for HART** (e.g. 99) or **<> 2457 for PROFIBUS-PA** (e.g. 2456) must be entered in "**unlock parameter**" **(0A4)** in the "**diagnostics**" **(0A)** function group. The lock is shown on the display by the symbol and can be released again either via the display or by communication.

**Hardware lock:**
The instrument is locked by pressing the + and − and E keys at the same time. The lock is shown on the display by the symbol and can **only** be unlocked again via the display by pressing the + and − and E keys at the same time again. It is **not** possible to unlock the hardware by communication.
All parameters can de displayed even if the instrument is locked.



### 11.5.2 Unlocking of configuration mode

If an attempt is made to change parameters when the instrument is locked, the user is automatically requested to unlock the instrument:

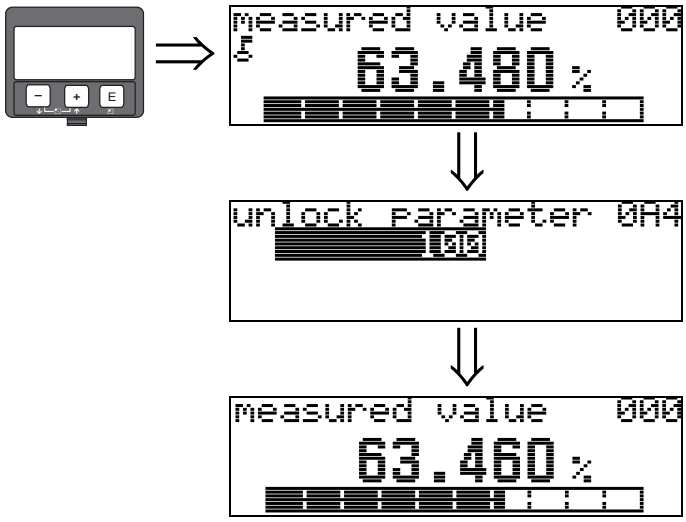
"**unlock parameter**" **(0A4):**
By entering the unlock parameter (on the display or via communication)

**100** = for HART devices

the 7500 RTG is released for operation.

**Hardware:**
After pressing the [+] and [−] and [E] keys at the same time, the user is asked to enter the unlock parameter

**100** = for HART devices

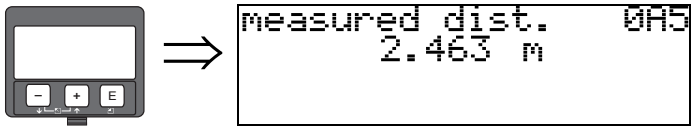



[+] and [−] and [E] press simultaneous

Please enter unlock code and confirm with [E].

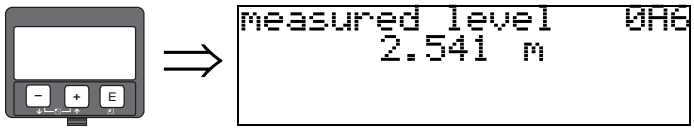
**Caution!**
Changing certain parameters such as all sensor characteristics, for example, influences numerous functions of the entire measuring system, particularly measuring accuracy. There is no need to change these parameters under normal circumstances and consequently, they are protected by a special code known only to the Varec service organization. Please contact Varec if you have any questions.

## 11.6 Function "measured dist." (0A5)

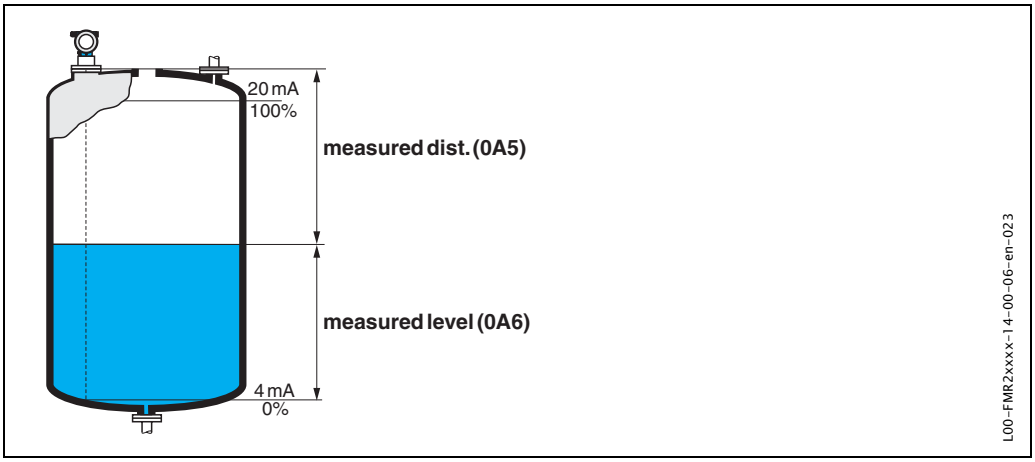



Display of measured distance in the selected "**distance unit**" **(0C5)**.

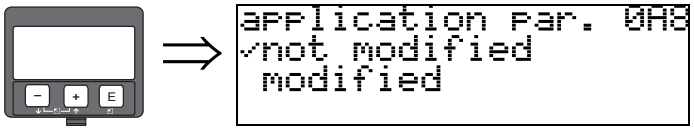
## 11.7 Function "measured level" (0A6)



Display of measured level in the selected "**distance unit**" **(0C5)**.




## 11.8 Function "application par." (0A8)




Displays whether or not one of the settings dependent on the "**tank shape**" **(002)**, "**medium property**" **(003)** and "**process cond.**" **(004)** application parameters has been changed or not.
If, for example, the "**output damping**" **(058)** is changed, the "**application par.**" shows "**modified**".

**Selection:**

- not modified
- modified

## 11.9 Function "custody mode" (0A9)

This indicates the instrument calibration mode. The calibration mode (active) can be set using the hardware security lock on the electronics (see page 13).

**Selection:**

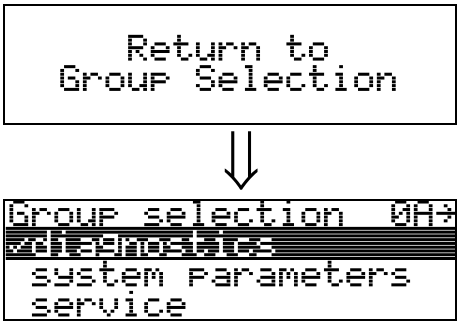
- inactive
- active pos.
- active neg.

**inactive**
The custody mode is not activated (switch for custody mode is open, see page 15)

**active pos.**
The custody mode (instrument is lead-sealed and accurate to the nearest mm) is active and is held.

**active neg.**
Custody mode (instrument is lead-sealed and accurate to the nearest mm) is activated and not held, e.g. because the signal-to-noise ratio is less than 10 dB (refer to "**echo quality**" **(056)** function in the "**extended calibr.**" **(05)** function group).

**Caution!**
After entering all the values and completing mounting and aligning work, enter the Reset Code "**555**" in the "**reset**" **0A3)** function to reset the instrument history for auto-correction.




After 3 s, the following message appears

# 12 Function group "system parameters" (0C)

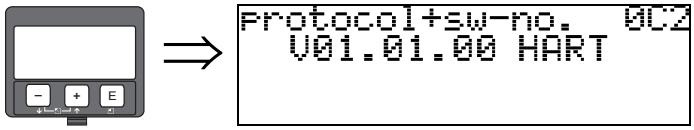
## 12.1 Function "tag no." (0C0)

You can define the tag number with this function.

**User input:**

- 16 alphanumeric characters for HART instruments (8 using the HART universal command)

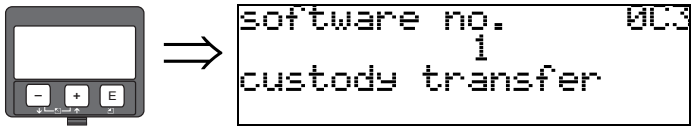
## 12.2 Function "protocol+sw-no." (0C2)




This function shows the protocol and the hardware and software version: Vxx.yy.zz.prot.

**Display:**
xx: hw-version
yy: sw-version
zz: sw-revision
prot: protocol type (e.g. HART)

## 12.3 Function "software no." (0C3)




This function displays the version number of the weight and measure approved part of the Software.

## 12.4 Function "serial no." (0C4)

This function displays the instrument serial number.

## 12.5 Function "distance unit" (0C5)

You can select the basic distance unit with this function.

**Selection:**

- m
- ft
- mm
- inch

**Dependence**
m, mm: "**format display**" **(094)** can only be "**decimal**".

The units are changed for the following parameters:

- empty calibr. (005)
- full calibr. (006)
- pipe diameter(007)
- safety distance (015)
- input level (044)
- diameter vessel (047)
- range of mapping (052)
- cust. tank map (055)
- offset (057)
- simulation value (066)
- measured dist. (0A5)
- measured level(0A6)

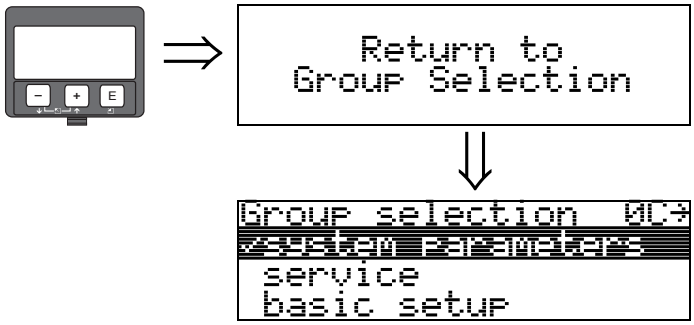
## 12.6 Function "download mode" (0C8)

This parameter defines which values are written to the instrument during a ToF Tool or Commuwinn II configuration download.

**Selection:**

- parameter only
- param+cust.map
- mapping only

**Note!**
This parameter must not be described explicitly in ToF Tool. The various possibilities can be selected from the download dialog.




After 3 s, the following message appears

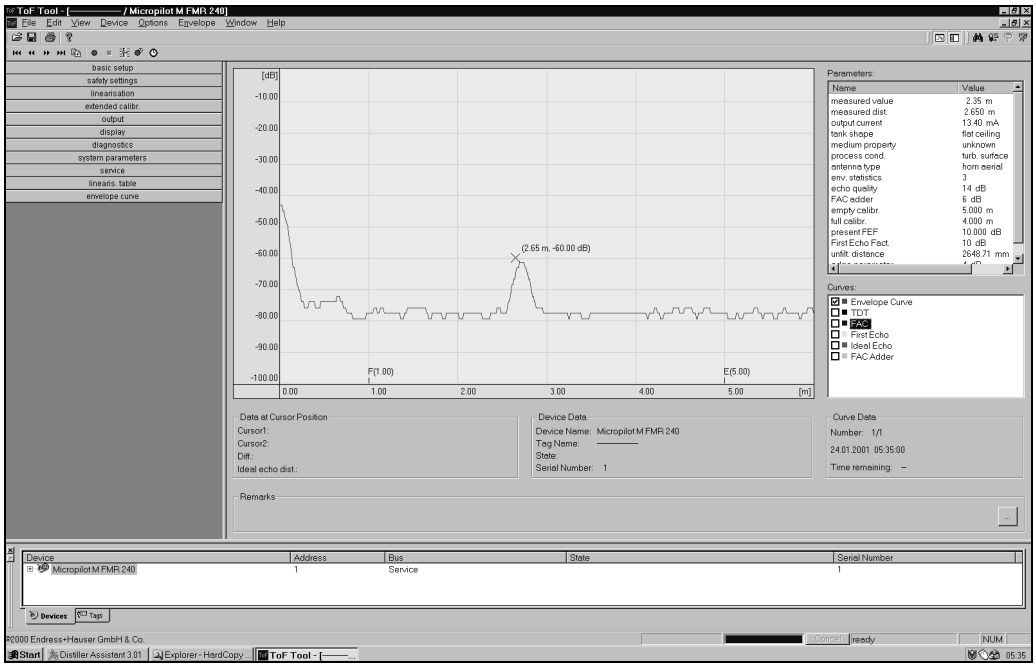
# 13 Function group "service" (0D)

You can find a detailed description of the "Service" function group as well as a detailed overview of the function menu in the Service Manual: SM 09F.

# 14 Envelope curve

## 14.1 Envelope curve with the ToF Tool

### Signal analysis via envelope curve




See page 67 for the envelope curve in the local display.

## 14.2 Tank mapping

**Generation of an envelope curve**

Depending on the distance, the electromagnetic wave with a frequency of approx. 6 GHz requires a time-of-flight between 1 ns and 270 ns. The reflected signal is expanded by means of a sampling process to approximately 0.3 ms to 20 ms.
The sampling factor for 6 GHz is 81920; it is 163 840 for 26 GHz. The resulting carrier frequency is approx. 70 kHz, and 140 kHz at 26 GHz, respectively.
The envelope curve generated such is then demodulated, processed to a logarithmic scale, amplified and finally digitalized and evaluated by a microprocessor.
In chronological order, an envelope curve consists of the sending pulse, the electrical reverberation and one or more echoes.
The maximum measuring time depends on the maximum measuring distance. Afterwards, the next cycle starts with the sending pulse.
The envelope curve can be viewed on the local display. In order to do that, the function 09C must be selected in the operation menu. The display can be configured in function 09A and 09B. In addition, a laptop computer or PC in combination
with the Varec software “ToF Tool” and an interface adapter can be used for display and evaluation of an envelope curve. (see BA 224F – Operating Instructions for ToF Tool).

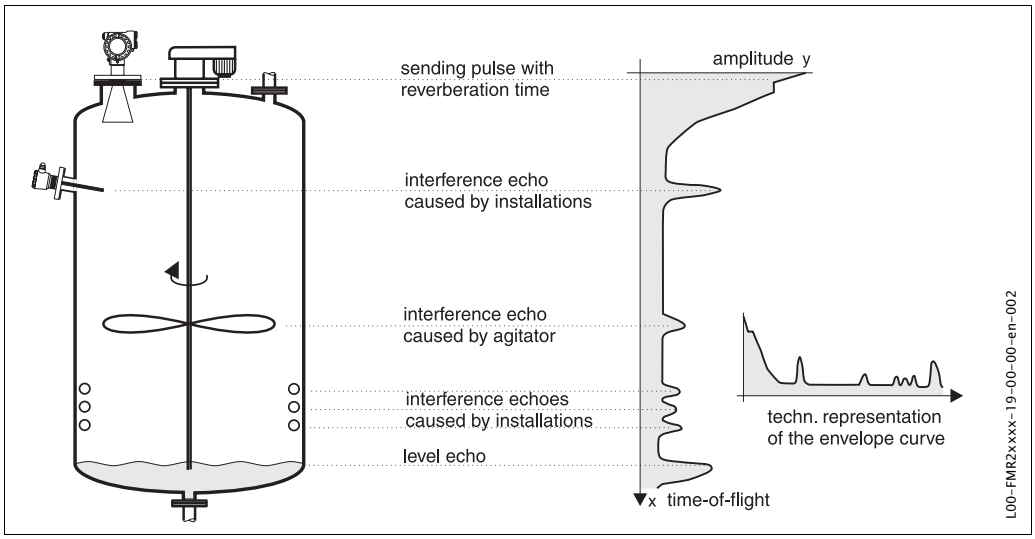
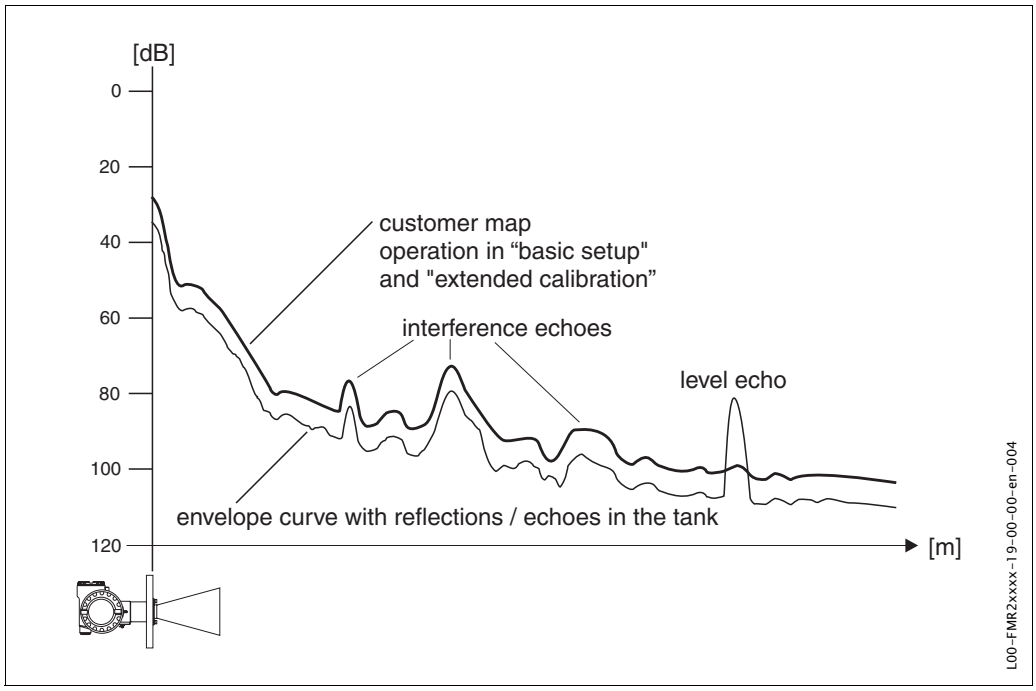



Figure 5: Example of a tank with a schematic envelope curve

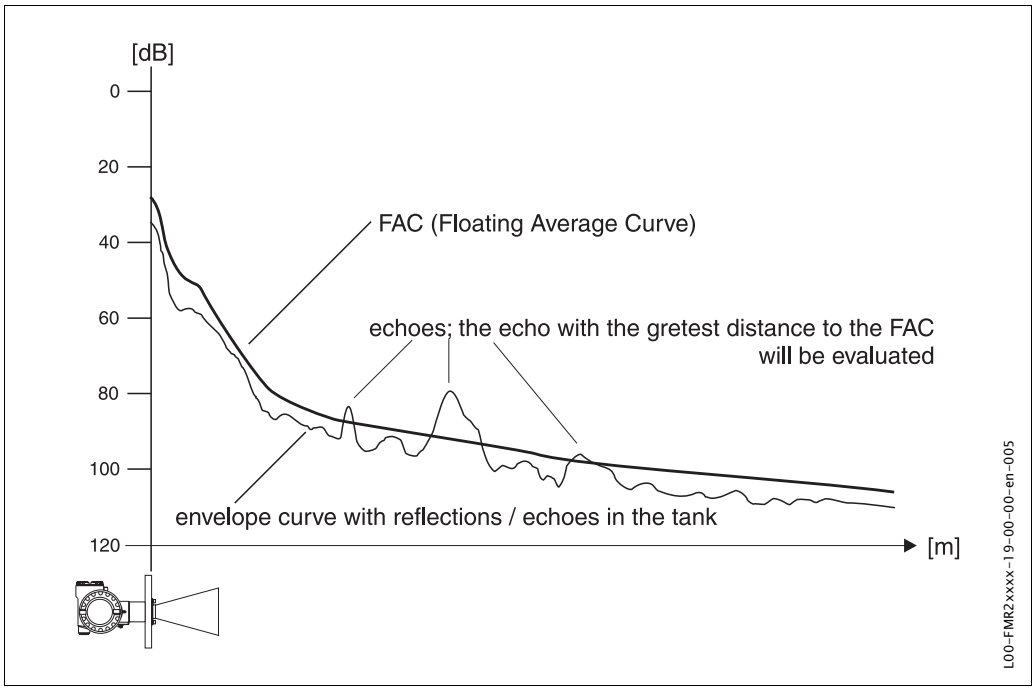
### Tank mapping

It may be required to map interference reflections inside the tank.This map is preferably done with an empty tank. This way, all eventual interference reflections caused by installations in the tank are detected and stored in memory.
Only significant echoes will then exceed the tank map and be evaluated.
The mapping can also be performed up to the level or a defined distance, even if the tank is not empty. However, if the level drops below the mapping distance, additional reflections can interfere with the measurement.



### The FAC (Floating Average Curve)

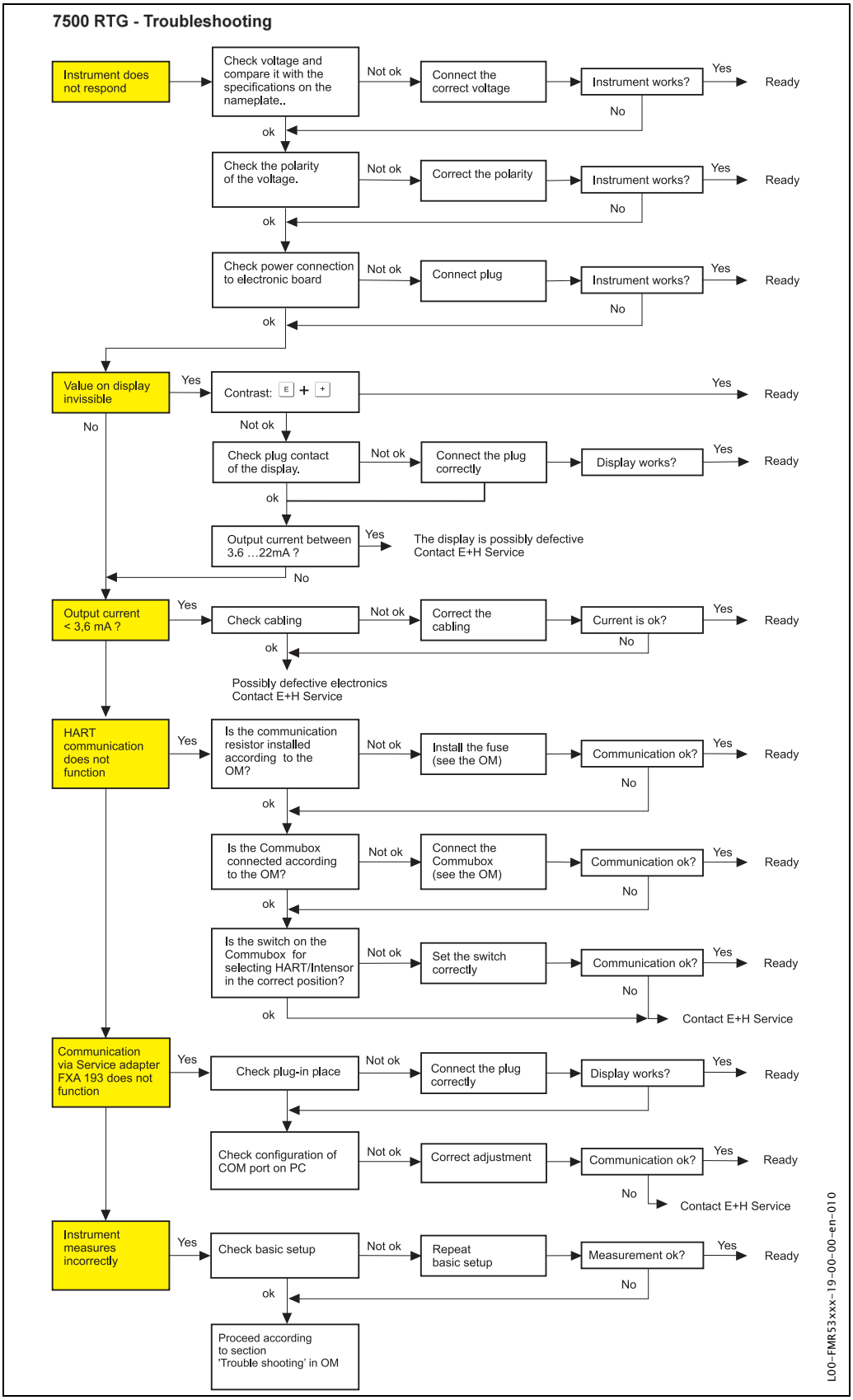
The FAC is similar to the tank map, but automatically adapts itself to changing interference echoes in the tank, i.e. caused by buildup and turbulences. The FAC only covers small interference reflections, all signals below this curve are ignored.
The echo signal with the greatest distance to the FAC will be evaluated.
The FAC is not only recorded once, but newly calculated with every envelope curve. Thus, it continuously adapts itself to the conditions in the tank.



# 15 Troubleshooting

If you have followed the instructions in this operating manual, the 7500 RTG should work correctly. If this is not the case, 7500 RTG has facilities for analysing and correcting errors.
You can find a structured approach for locating errors on page 90 or in the appropriate instrument operating manual.

# 15.1 Troubleshooting instructions



## 15.2 System error messages

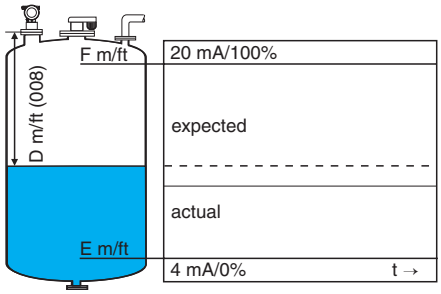
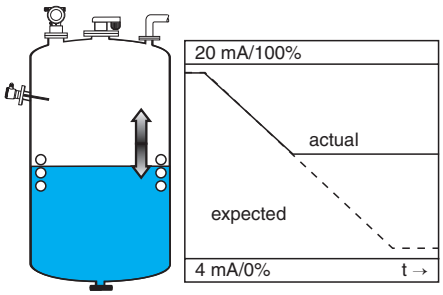
| Code | Description | Possible cause | Remedy |
|---|---|---|---|
| A101 | checksum error general reset & new calibr.required | | reset; if alarm prevails after reset, exchange electronics |
| A102 | checksum error general reset & new calibr.required | device has been powered off before data could be stored; emc problem; E²PROM defect | reset; avoid emc problem; if alarm prevails after reset, exchange electronics |
| W103 | initialising – please wait | E²PROM storage not yet finished | wait some seconds; if warning prevails, exchange electronics |
| A106 | downloading please wait | processing data download | wait until warning disappears |
| A110 | checksum error general reset & new calibr.required | device has been powered off before data could be stored; emc problem; E²PROM defect | reset; avoid emc problem; if alarm prevails after reset, exchange electronics |
| A111 | electronics defect | RAM defective | reset; if alarm prevails after reset, exchange electronics |
| A113 | electronics defect | ROM defective | reset; if alarm prevails after reset, exchange electronics |
| A114 | electronics defect | E2PROM defective | reset; if alarm prevails after reset, exchange electronics |
| A115 | electronics defect | general hardware problem | reset; if alarm prevails after reset, exchange electronics |
| A116 | download error repeat download | checksum of stored data not correct | restart download of data |
| A121 | electronics defect | no factory calibration existant; E²PROM defective | contact service |
| A152 | checksum error general reset & new calibr.required | device has been powered off before data could be stored; emc problem; E²PROM defect | reset; avoid emc problem; if alarm prevails after reset, exchange electronics |
| W153 | initialising – please wait | initialisation of electronics | wait some seconds; if warning prevails, power off device and power on again |
| A155 | electronics defect | hardware problem | reset; if alarm prevails after reset, exchange electronics |
| A160 | checksum error general reset & new calibr.required | device has been powered off before data could be stored; emc problem; E²PROM defect | reset; avoid emc problem; if alarm prevails after reset, exchange electronics |

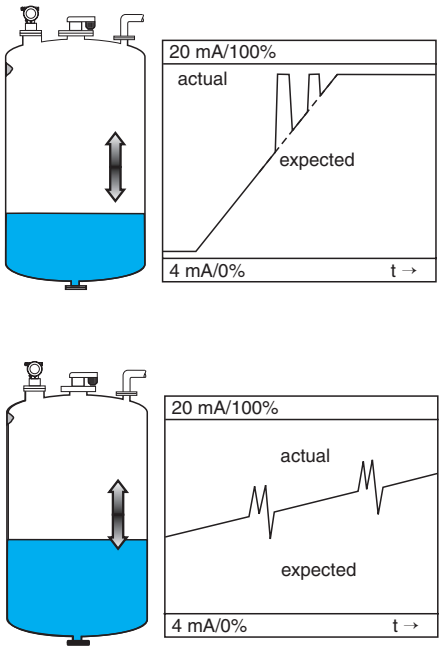
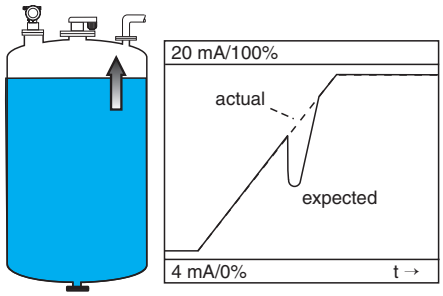
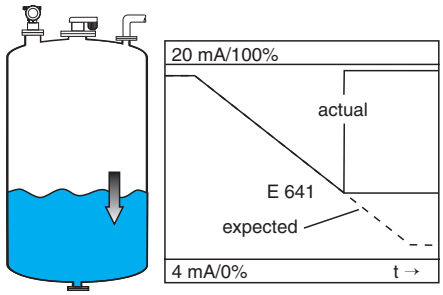
*Table 3: System error messages*

| Code | Description | Possible cause | Remedy |
|---|---|---|---|
| A164 | electronics defect | hardware problem | reset;<br>if alarm prevails after reset, exchange electronics |
| A171 | electronics defect | hardware problem | reset;<br>if alarm prevails after reset, exchange electronics |
| A231 | sensor 1 defect<br>check connection | HF module or electronics defective | exchange HF module or electronics |
| A270 | custody switch undef<br>check position | switch for custody transfer may be defective | check position of custody switch<br>exchange electronics |
| # | | inconsistency between phase and amplitude evaluation<br>inconsistent microfactor<br>inconsistent index mapping | check basic calibration<br>check mounting calibration<br>check echo quality<br>reset history "555"<br>check stilling pipe diameter<br>switch off autocorrection |
| A272 | electronics defect amplifier | inconsistency in amplification | exchange electronics |
| W275 | electronics defect factory setting | offset drift of A/D commuter | exchange electronics |
| W511 | no factory calibration ch1 | factory calibration has been deleted | record new factory calibration |
| A512 | recording of mapping please wait | mapping active | wait some seconds until alarm disappears |
| W601 | linearisation ch1 curve not monotone | linearisation not monotonously increasing | correct linearisation table |
| W611 | less than 2 linearisation points for channel 1 | number of entered linearisation points < 2 | correct linearisation table |
| W621 | simulation ch. 1 on | simulation mode is active | switch off simulation mode |
| E641 | no usable echo channel 1<br>check calibr. | echo lost due to application conditions of built up on antenna | check installation;<br>optimize orientation of antenna; clean antenna (cf. Operating Instructions) |
| E651 | level in safety distance - risk of overspill | level in safety distance | alarm will disappear as soon as level leaves safety distance; |
| A671 | linearisation ch1 not complete, not usable | linearisation table is in edit mode | activate linearisation table |
| W681 | current ch1 out of range | current out of range (3,8 mA ... 21,5 mA) | check calibration and linearisation |

*Table 3: System error messages*

## 15.3 Application errors

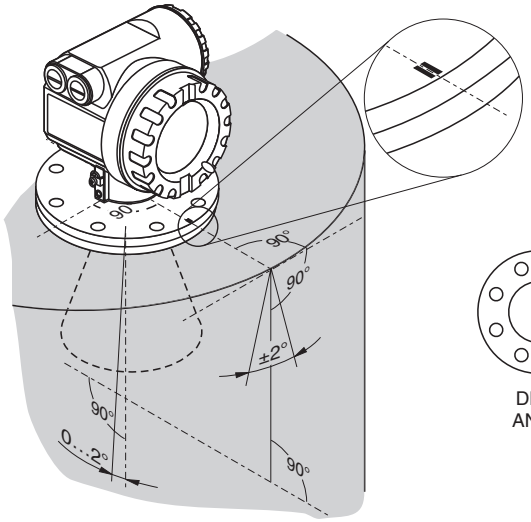
| Error | Output | Possible cause | | Remedy |
|---|---|---|---|---|
| **A warning or alarm has occurred.** | Depending on the configuration | See table of error messages (see page 91) | | 1. See table of error messages (see page 91) |
| **Measured value (00) is incorrect** |  | Measured distance (008) OK? | yes → | 1. Check empty calibr. (005) and full calibr. (006).<br>2. Check linearisation:<br>→ level/ullage (040)<br>→ max. scale (046)<br>→ diameter vessel (047)<br>→ Check table |
| | | no ↓ | | |
| | | Measurement in bypass or stilling well? | yes → | 1. Is bypass or stilling well selected in tank shape (002)?<br>2. Is the pipe diameter (007) correct? |
| | | no ↓ | | |
| | | Is an FAR 10 antenna extension being used? | yes → | 1. offset (057) correctly set? (see page 58) |
| | | no ↓ | | |
| | | An interference echo may have been evaluated. | yes → | 1. Carry out tank mapping → basic setup |
| **No change off measured value on filling/empty-ing** |  | Interference echo from installations, nozzle or extension on the antenna | | 1. Carry out tank mapping → basic setup<br>2. If necessary, clean antenna<br>3. If necessary, select better mounting position |

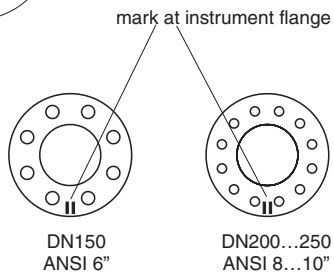
| Error | Output | Possible cause | | Remedy |
|---|---|---|---|---|
| **If the surface is not calm (e.g. filling, emptying, agitator running), the measured value jumps sporadically to a higher level** |  | Signal is weakened by the rough surface — the interference echoes are sometimes stronger | | 1. Carry out tank mapping → basic setup<br>2. Set the process cond. (004) to "turb. surface" or "agitator"<br>3. Increase the output damping (058)<br>4. Optimise the orientation (see page 95)<br>5. If necessary, select a better mounting position and/or larger antenna |
| **During filling/ emptying the measured value jumps downwards** |  | Multiple echoes | yes → | 1. Check the tank shape (002), e.g. "dome ceiling" or "horizontal cyl"<br>2. In the range of the blocking dist. (059) there is no echo evaluation → Adapt the value<br>3. If possible, do not select central installation position<br>4. Perhaps use a stilling well |
| **E 641 (loss of echo)** |  | Level echo is too weak.<br>Possible causes:<br>• Rough surface due to filling/ emptying<br>• Agitator running<br>• Foam | yes → | 1. Check application parameters (002), (003) and (004)<br>2. Optimise alignment (see page 95)<br>3. If necessary, select a better installation position and/or larger antenna |
| **E 641 (loss of echo) after turn on the power supply** | **If the instrument is configured to Hold by loss of echo the output is set to any value/current.** | noise level during the initialisation phase to high. | | Repeat once more empty calibr. (005).<br>Caution!<br>Before conformation change with [+] or [−] to the edit mode. |

# 15.4 Orientation of the 7500 RTG

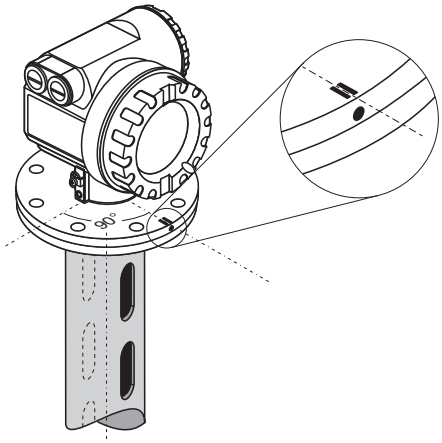
**At mounting adjust the marking at the instrument flange!**

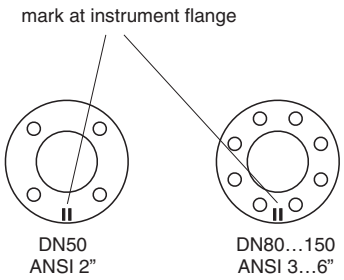
**Installation in tank (free space):**
**Mark on process connector facing the nearest tank wall!**




**Installation in stilling well:**
**Mark on process connector of FMR 530 pointed towards the slots or vent holes!**

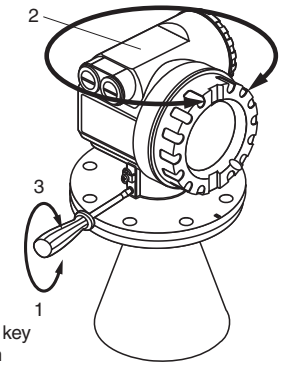



## Turn housing

The housing can be turned 350° in order to simplify access to the display and the terminal compartment

**T12 housing**




Allen key
4 mm
tighten strongly
by hand

L00-FMR53xxx-17-00-00-en-007

For orientation a marker is found on the flange or threaded boss of the 7500 RTG 7530 RTG/7531 RTG/7533 RTG. The measurement performance of the planar version 7532 RTG is independent of the orientation. During installation this must be oriented as follows (see page 95):

- In tanks: to the vessel wall
- In stilling wells: to the slots
- In bypass pipes: vertical to the tank connectors

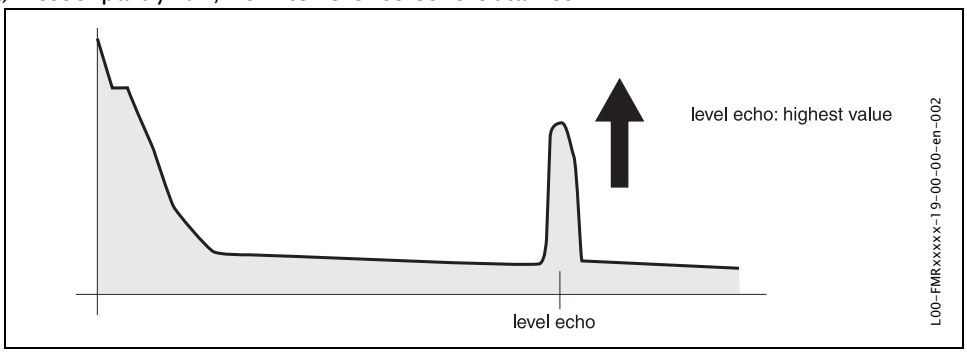
After commissioning the 7500 RTG, the echo quality indicates whether a sufficiently large measuring signal is obtained. If necessary, the quality can be optimised later. Vice versa, the presence of an interference echo can be used to minimize this by optimum orientation. The advantage of this is that the subsequent tank mapping uses a somewhat lower level that causes an increase in the strength of the measuring signal.

Proceed as follows:

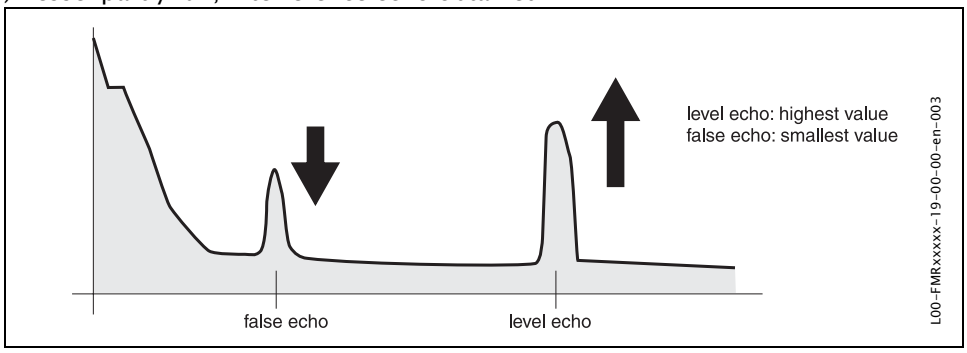
**Warning!**
Subsequent alignment can lead to personal injury. Before you unscrew or loosen the process connection, make sure that the vessel is not under pressure and does not contain any injurious substances.

1. It is best to empty the container so that the bottom is just covered. However, alignment can be carried out even if the vessel is empty.
2. Optimisation is best carried out with the aid of the envelope graph in the display or the ToF Tool.
3. Unscrew the flange or loosen the threaded boss by a half a turn.
4. Turn the flange by one hole or screw the threaded boss by one eighth of a turn. Note the echo quality.
5. Continue to turn until 360° is reached.
6. Optimum alignment:

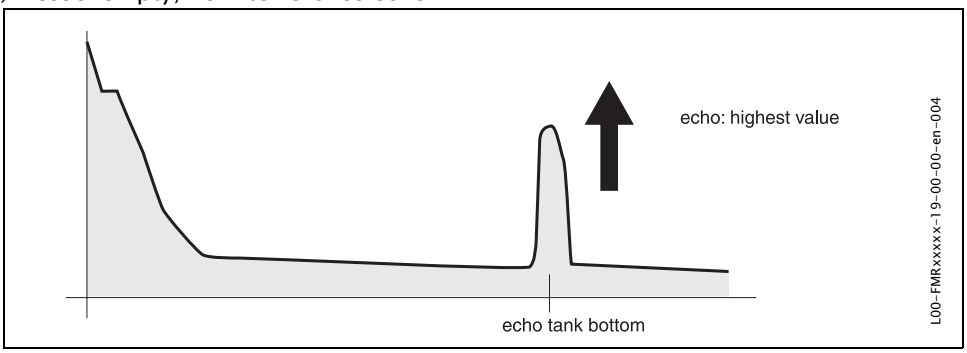
a) Vessel partly full, no interference echo obtained:



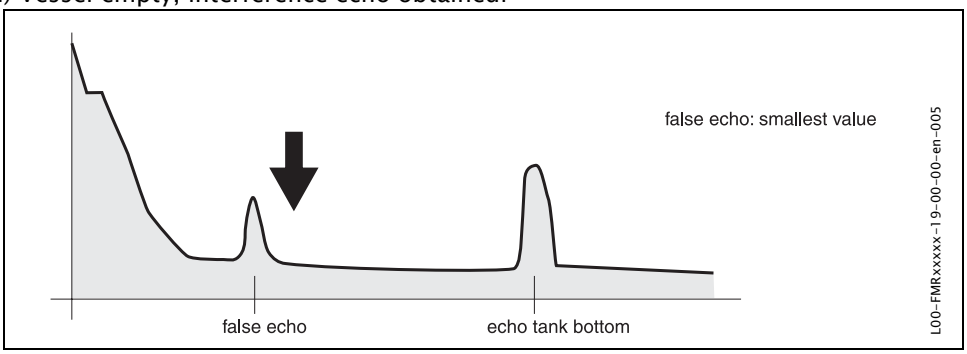

b) Vessel partly full, interference echo obtained:



c) Vessel empty, no interference echo:




d) Vessel empty, interference echo obtained:




5. Fix the flange or threaded boss in this position.
   If necessary, replace the seal.
6. Carry out tank mapping, see page 26.

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Notes

**Your offical representative**

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